IDGE AND BUILDING
ONVENTION NUMBER

NOVEMBER, 1940

Railway
Enginee
and
Mainte

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Illinois. Subscription price: United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Here's a superior "COMMON" NUT

BETHLEHEM HOT-FORGED NUTS have these positive advantages

Threads are free from cracks and strains

Metal in sidewall is tough and uniformly sound

Corners are sharp

Sides are smooth

Good bearing surface

THE Bethlehem Hot-Forged Nut should not be confused with nuts made by the old method of hot pressing and punching which tears the steel and does not produce nuts equal in appearance, density and uniformity in dimensions.

In Bethlehem's plant hot forging machines form the nut while the steel is in a plastic condition, thereby imparting to the finished product a number of important characteristics not found in nuts made by the cold process or in ordinary hot pressed nuts.

As a result of the hot forging process of manufacture, the steel in Bethlehem Hot Forged Nuts is uniform and strong throughout and offers greatest resistance to fatigue from vibration in the threads and wall of the nut. There are no cracks or cold strains, hence these nuts do not split. They withstand the standard drift test without producing any indication of failure.

* * *

Bethlehem Hot Forged Nuts are furnished in the classifications known to the trade as Hot Punched, Cold Punched, and Semi-Finished.

For the Hot Punched classification the Bethlehem nuts are formed in the hot forging machines and are furnished in the "as forged" condition.

For the Cold Punched classification the Bethlehem nuts are formed in the hot forging machines and are trimmed on the sides to provide a finish on the wrench surfaces.

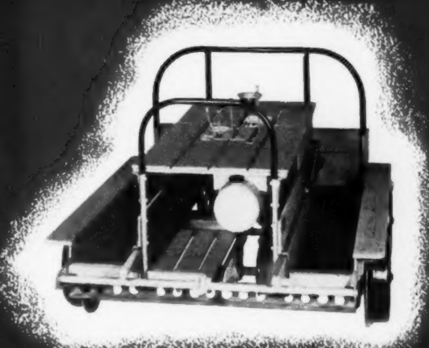
For the Semi-Finished classification the Bethlehem nuts are formed in the hot forging machines, trimmed on the sides to provide a finish on the wrench surfaces, and machined on the bearing surfaces.

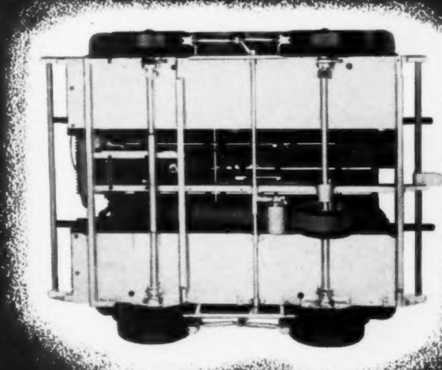
Order a Trial Lot—*We recommend Hot-Forged Nuts wherever a more accurate, dependable and stronger nut is required. Order a trial lot and note the superior qualities of these nuts.*

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

On every Fairmont inspection and section car, reinforced hickory lift handles extending from the front or the rear, provide extra leverage for swinging the car from the track. The rail skid between the front and rear wheels further simplifies the job.





Designed for EASY HANDLING

Fairmont Railway Motor Cars Set The Standard In Light Weight Construction

Because easier handling means greater safety for the men, cars and other property of the railroad, Fairmont has constantly led in features that make for better car control. They have worked with metallurgists in developing special alloys and specially fabricated parts that combine great strength with light weight. In achieving this goal, they have kept well in mind the importance of durability. The result is equipment which, while easy to handle, is also easy and economical to maintain. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Fairmont

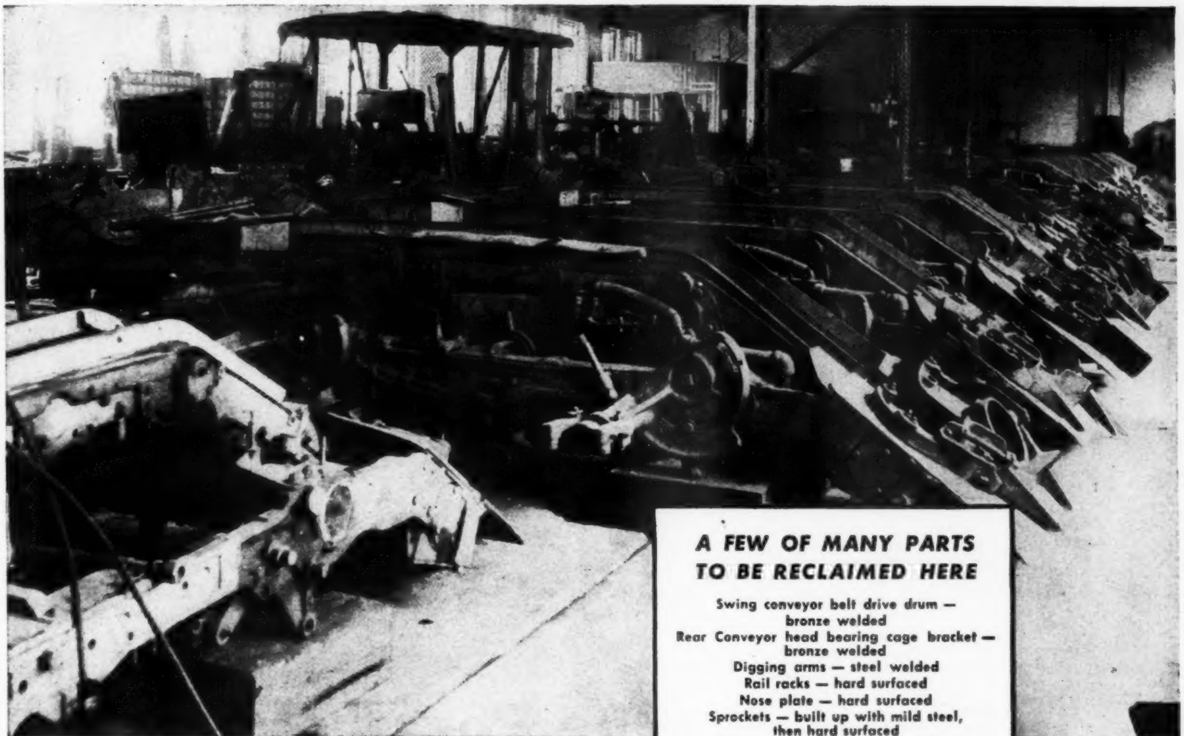
Performance ON THE JOB COUNTS

M14 SERIES G Light Section Car. Seats 1 to 6 men; can tow a 3 000 lb. load on a trailer up a ½% grade at 24 m.p.h.

OF ALL THE CARS IN SERVICE TODAY ★ ★ *More Than Half are Fairmonts*


WOOLERY
TIE CUTTER

NOW IS THE TIME TO RECONDITION YOUR EQUIPMENT



A FEW OF MANY PARTS TO BE RECLAIMED HERE

Swing conveyor belt drive drum — bronze welded
Rear Conveyor head bearing cage bracket — bronze welded
Digging arms — steel welded
Rail racks — hard surfaced
Nose plate — hard surfaced
Sprockets — built up with mild steel, then hard surfaced

...DO IT THIS SURE, ECONOMICAL AIRCO WAY

Now that the working season is over, you will be shopping and reconditioning work equipment for Spring use. A sure, quick, inexpensive way to be prepared is to fully utilize the Airco Oxyacetylene Processes.

The ballast moles pictured here, in for repair, are typical of the equipment repair problems profitably solved by the application of oxyacetylene welding and hard facing. Worn parts will be built up, then hard-faced for longer service . . . broken parts will be welded — at a fraction of the cost and time which replacement would require. When reconditioned, the moles will be as serviceable as new.

The savings made possible with time-proved Airco methods and equipment are important. Airco customers reduce their maintenance costs through the use of Airco 99.5% pure oxygen, acetylene, apparatus, and the practical advice of the members of our Applied Engineering Department. Write any Airco District Office for full details.

AIR REDUCTION

General Offices: **60 EAST 42nd ST., NEW YORK, N. Y. DISTRICT OFFICES IN PRINCIPAL CITIES**

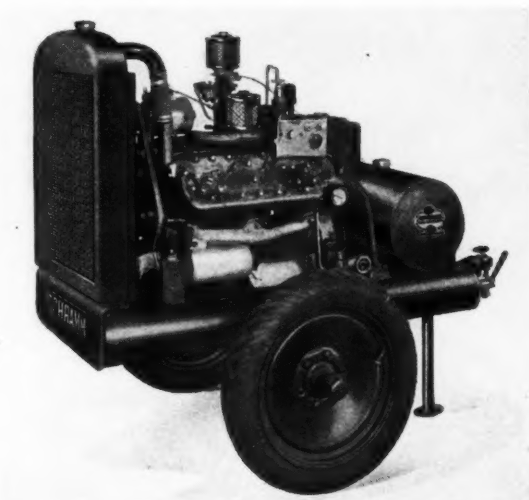
• SERVING RAILROADS FROM COAST TO COAST •

COMPRESSORS *for*

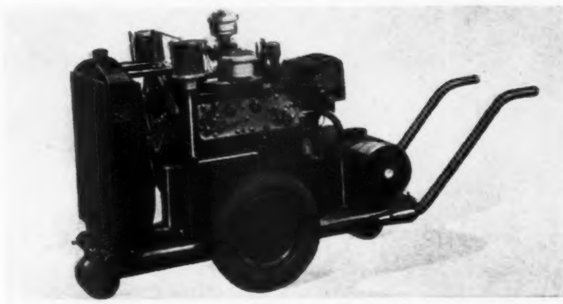
BRIDGES and BUILDING MAINTENANCE

MODEL 60. Mounted in rail car, self-propelled, carries men and equipment to and from the job, easily derailed by the crew.

MODEL 60. Standard two wheel trailer, easily moved by two men, can be towed behind any car or truck at high speed.



MODEL 40. Standard two wheel trailer, without hood, complete operating accessories, 33" wide over all.



MODEL 60. Mounted on two pneumatic tired wheels for moving on the flat, 32" wide over all, weight 965 lbs.; also has two double flanged wheels for faster moving on one rail.

WRITE FOR SPECIAL BULLETIN

SCHRAMM INC.

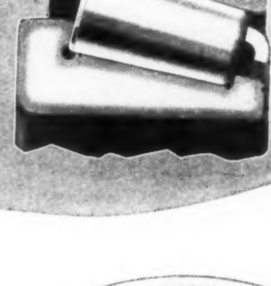
ESTABLISHED 1900

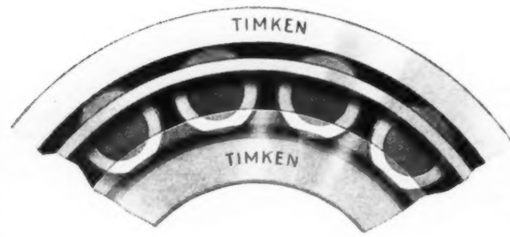
WEST CHESTER, PENNA.

SCHRAMM 40 and 60 cu. ft. compressors are light weight, compact, easily serviced units. They will operate almost any pneumatic tool used in Bridge and Building Maintenance, rivetting hammers, chippers, scalers, wire brushes, paint sprays, wood borers, paving breakers, steel drills, rock drills.

The TIMKEN *Bearing of Today*

WITH 42 YEARS OF DEVELOPMENT BEHIND IT . . .





THESE X-ray pictures show the highly-refined TIMKEN Bearing of today—with all of the vitally important improvements that have been made since Timken introduced the first TIMKEN Bearing 42 years ago. Such improvements as *positive roller alignment* through wide-area contact of roller ends with the undercut rib of the cone; the *one-piece multiple-perforated cage* which assures dead-accurate spacing of the rollers around the periphery of the bearing; TIMKEN Electric Furnace Alloy Steel for supreme strength and endurance; and TIMKEN Bearing finish—the finest finish known to modern bearing science.

The consummation of these improvements has resulted in the highest quality and most efficient tapered roller bearings ever produced—with performance that is correspondingly outstanding; all designated by the trade-mark "TIMKEN" stamped on the cone and cup of every TIMKEN Bearing.

It will pay you well to make sure that every piece of machinery you buy is Timken Bearing Equipped.

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

TIMKEN

TAPERED ROLLER BEARINGS

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TO RAILWAY SUPPLY MANUFACTURERS

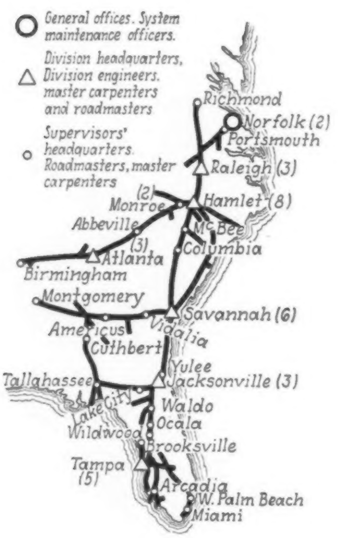
"In Business to Stay"

"Boss, that was a swell order that you landed from the Government last week. It ought to keep our plant busy for months," said the star railway salesman to his sales manager.

"Yes, Bill," replied the sales manager, "that order did run into big figures."

"It'll certainly be fine to be able to take it easy for a while, after the pressure we've been working under during the last six or eight years getting enough orders to keep the plant running."

"Take it easy? That's what I'm afraid of. Bill, you're going to have to hit the road harder than ever."



Railway Engineering and Maintenance goes every month to 53 supervisory maintenance officers on the Seaboard Air Line at the **system headquarters, at six division headquarters and at 21 other supervisory headquarters,** scattered all the way from Richmond and Norfolk, Va., to West Palm Beach, Fla. This magazine also goes to 14 other subordinate maintenance officers who are in training for promotion to supervisory positions on this railway.

"But, Boss. How do you figure that out?"

"That's simple, Bill. You and I've worked too hard building up our railway business to let it go to our competitors now, just because our government needs our help for a short time. It's *your* job to hold it."

"What can I do?"

"Just this. You've got to keep in closer contact with our railway friends than ever. Tell them that while our plant capacity will be taken for a few months producing materials needed in national defense, we'll be able to take care of their needs in a short time. Don't let any of them forget us."

"I get you, Boss. You're looking beyond this temporary emergency to the years ahead. You've got a long head on you."

"It's just plain common sense, Bill. These war orders won't last forever. And when they're over, we'll need our railroad business again and need it badly. It's our bread and butter."

"And how about our advertising in *Railway Engineering and Maintenance?*"

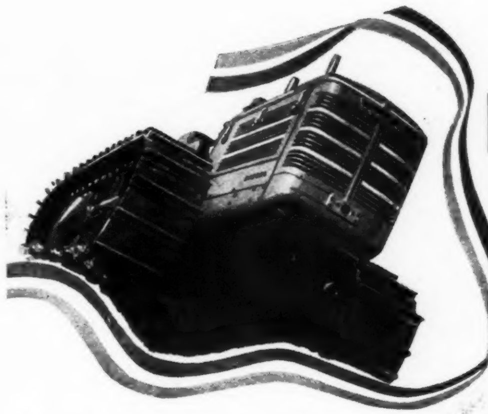
"We're going to continue that, too. It's just another form of calling."

"That's right, Boss,—and that magazine goes into a lot of offices I never get to. Take the Seaboard Air Line, for illustration. I get into Norfolk and Hamlet and Savannah, but I never get to Abbeville and Arcadia and more than 20 other towns on that railroad where that magazine carries our story to maintenance officers every month."

"That's what I have in mind. We've got to maintain our contacts with our friends on these railways through both calling and advertising. The only difference in our problem now is that our story is changed a little for the time being."

"But it's just as important, Boss. We're in business to stay."

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS



Keep on the Profit Side with INTERNATIONAL TRACTRACTORS

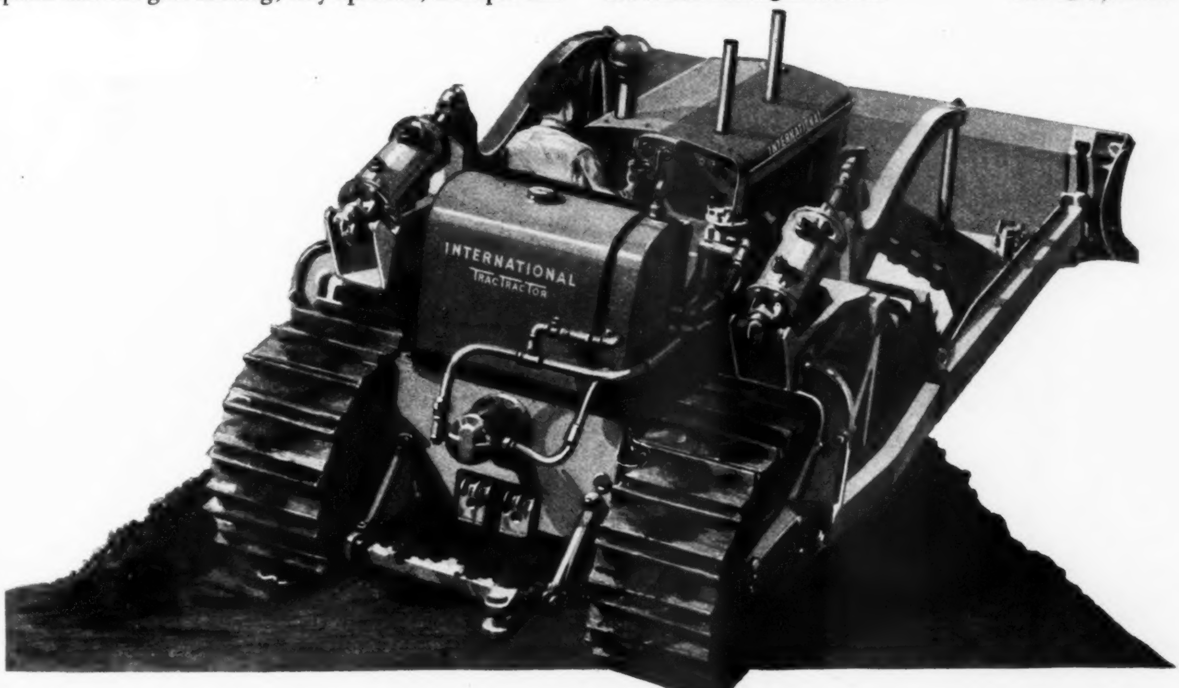
In terms of *performance, operating economy, low maintenance,* and *long life,* the FOUR NEW INTERNATIONAL DIESEL TRACTRACTORS are in a class by themselves . . . far ahead of anything you've seen yet in crawler power. The big TD-18 set a new pace when it got on the job last year. The TD-14, TD-9, and the small TD-6 are following right on its heels with their good work.

This quartet of streamlined efficiency has *everything* users have needed and asked for in crawler tractors . . . features and qualities that put TracTracTors well in advance of the market. On-the-job evidence proves the great value of such points as these: Quick, easy-starting, *full* International Diesel engines; wide range of traveling speeds and fast gear shifting; easy-operated, multiple-disk steering clutches; *exclusive* track frame stabilizer and ball-and-socket pivot construction which relieves the pivot shaft and track frame of leverage loads and assures positive track alignment; long-lived, quintuple-sealed track rollers; and accessibility that can't be matched.

Choose the size or sizes of TracTracTors best suited for your work. Pair the power up with balanced allied equipment. Then you'll have an outfit that knocks the spots out of anything it goes up against. Get acquainted with International Diesel TracTracTors—call the nearby International industrial power dealer or Company branch.

INTERNATIONAL HARVESTER COMPANY

180 North Michigan Avenue Chicago, Illinois



INTERNATIONAL Industrial Power

1941 BUDGETS

Should Include

BARCO

Type K-1 Light Weight Tytamper for all types of ballast and general tamping.

BARCO

UNIT TYTAMPERS

BARCO

Type TT-2 Heavy Duty Tytamper, for use where a very heavy blow is desired.

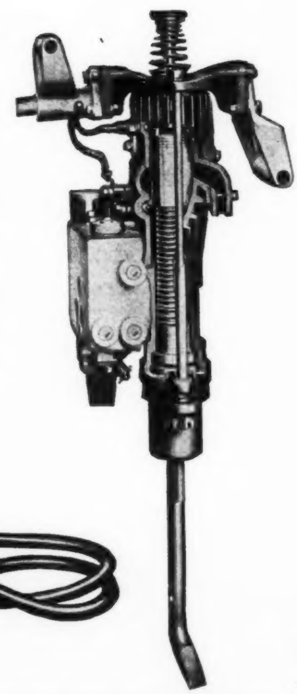
Lower Initial Capital Expense for Equipment.

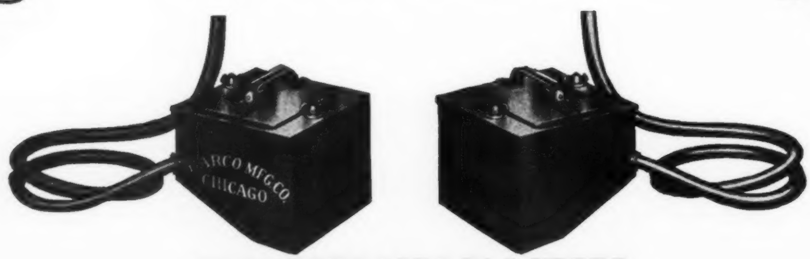
Lower Operating Cost.

All Year Around Service in Gangs or in Individual Units.

Entirely Self-Contained—Carried by One Man—No Auxiliary Equipment Required.

BARCO provides the Most Flexible, Convenient and Efficient Method of Maintaining Thoroughly Tamped Tracks, as Evidenced by Their Use on 65 Railroads.





ON 65 RAILROADS IN 5 YEARS

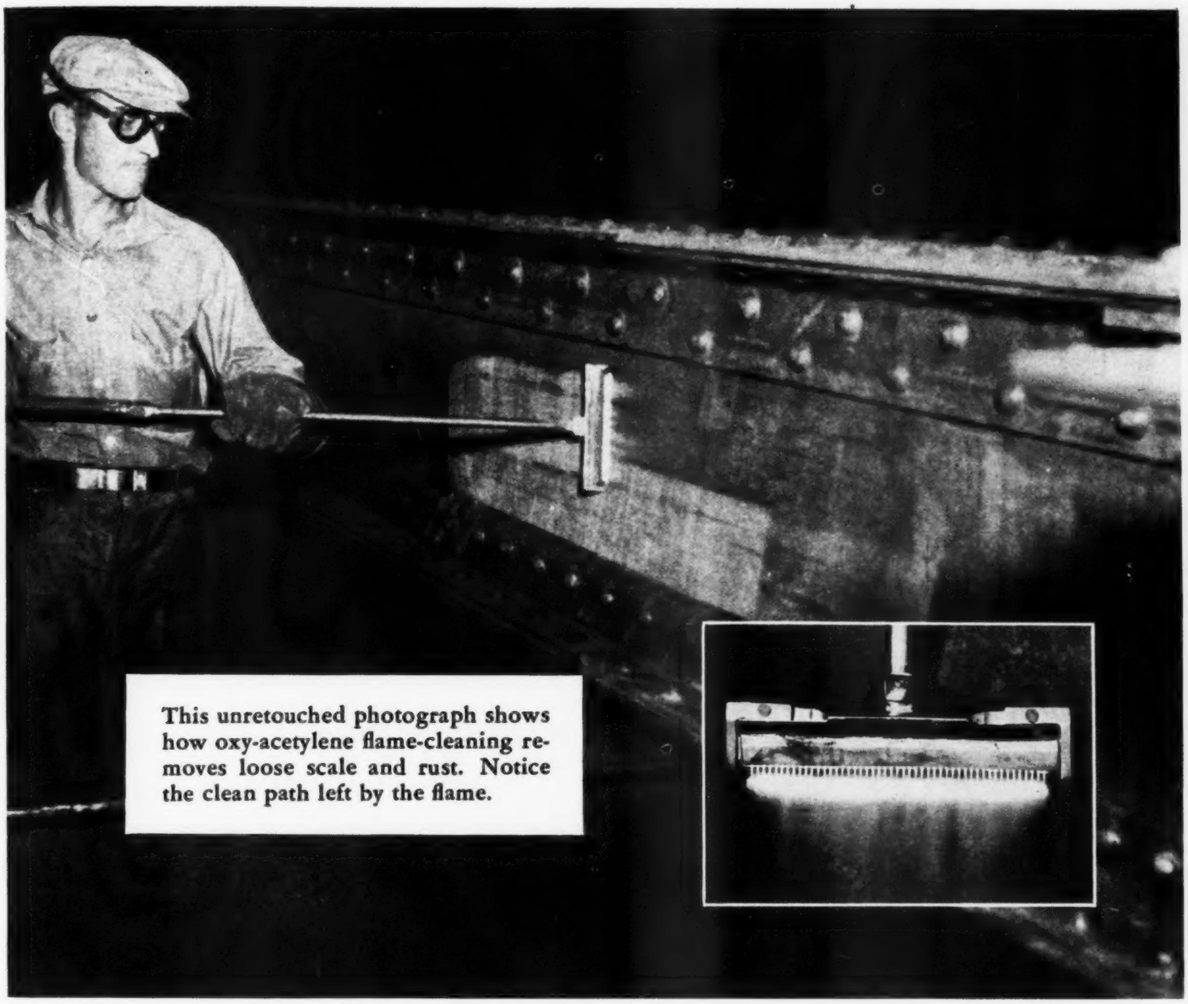
BARCO MANUFACTURING COMPANY

1805 W. Winnemac Ave. — Chicago, Illinois

In Canada

THE HOLDEN COMPANY, LTD.

Montreal — Moncton — Toronto — Winnipeg — Vancouver



This unretouched photograph shows how oxy-acetylene flame-cleaning removes loose scale and rust. Notice the clean path left by the flame.

Flame-Cleaning Makes Paint Last Longer on Steel Structures

• The oxy-acetylene process of flame cleaning while removing loose scale and rust from steel surfaces, also eliminates surface moisture, the major cause of subsequent corrosion and paint-flaking, and leaves the metal warm and dry to receive new paint. Paint then flows rapidly and bonds tightly to the warm steel surface, resulting in longer life for both surface coating and the metal underneath.

Oxweld representatives will be glad to discuss this application and to demonstrate how it can help railroads lower costs in the installation and maintenance of bridges, tanks, rail, and other steel subject to corrosion.

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
Carbide and Carbon Building   Chicago and New York

OXWELD RAILROAD SERVICE

SINCE 1912—THE COMPLETE OXY-ACETYLENE SERVICE FOR AMERICAN RAILROADS

No. 143 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

November 1, 1940

Subject: "Across the Seven Seas"

Dear Reader:

I often wish that I might share my desk with you for a time in order that you might see the comments that come in from readers, showing the frequency with which they are finding in Railway Engineering and Maintenance information of direct value to them in the solution of their problems. These comments are a source of keen pride to our staff, for they show that we are rendering what we believe to be one of our most valuable services to you. In this day of increasing specialization throughout industry, we recognize our function to be that of uncovering and bringing to your attention information regarding new methods, new devices and new materials that you would not otherwise be able to acquire without the expenditure of more time and money than the many other demands on you permit.

As you read our issues from month to month, I often wonder if you realize how widely this service ramifies. You are aware, of course, that Railway Engineering and Maintenance circulates among the maintenance officers of practically all of the other roads in the United States and Canada as widely as on your own road. I wonder, however, if you realize the extent to which officers of railways in more distant countries also read and find help from our magazine in the same way that you do. Such an instance came to our attention only a few days ago.

In our issue for April, 1940, you will recall that we published an article describing the track supervisor system in vogue on the Burlington and the Rock Island railways. Among several hundred officers of railways in other countries who subscribe to and receive Railway Engineering and Maintenance from month to month is the chief engineer of one of Argentine's largest systems. This engineer wrote the chief maintenance officers of the two railways referred to in the article, commenting on their practice and enclosing information regarding a somewhat similar practice that he has installed on his line which shows that "by a somewhat dissimilar development, the supervisor system has been adopted as a solution to our problems and is showing many proofs of its efficiency." This information appears on page 733 of this issue.

Such experiences show that the interest of railway maintenance men in the experiences of others with similar responsibilities is not confined to North America but extends around the world. Such knowledge tends to broaden the interest of railway men in the problems of fellow maintenance officers in remote corners of the world. We are happy to have a part in extending this co-operation "across the seven seas."

Yours sincerely,

Elmer T. Howson

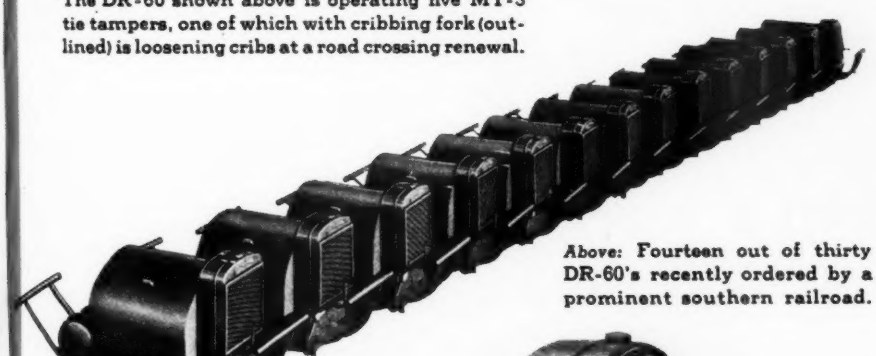
Editor

ETH:EW

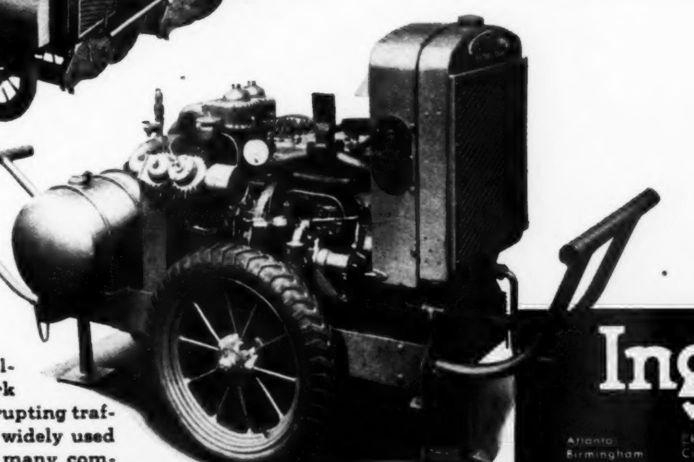
MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

GIVE EACH OF YOUR SECTION GANGS A DR-60 SPOT TAMPER

The DR-60 shown above is operating five MT-3 tie tampers, one of which with cribbing fork (outlined) is loosening cribs at a road crossing renewal.



Above: Fourteen out of thirty DR-60's recently ordered by a prominent southern railroad.



The DR-60 follows the work without interrupting traffic. It is also widely used for operating many combinations of other air tools.

The DR-60 is an easily transported, lightweight, "off-track" two-stage air compressor, that was designed especially for railroad use.

It will furnish more than enough air to operate 4 MT-3 tie tampers plus one cribbing fork.

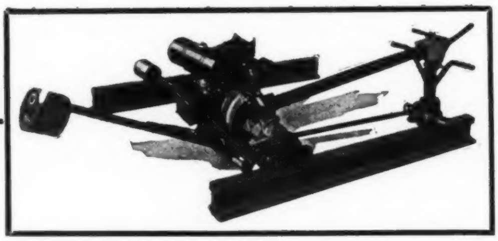
You will want to investigate this latest development in tie tamping equipment.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y. 956-11

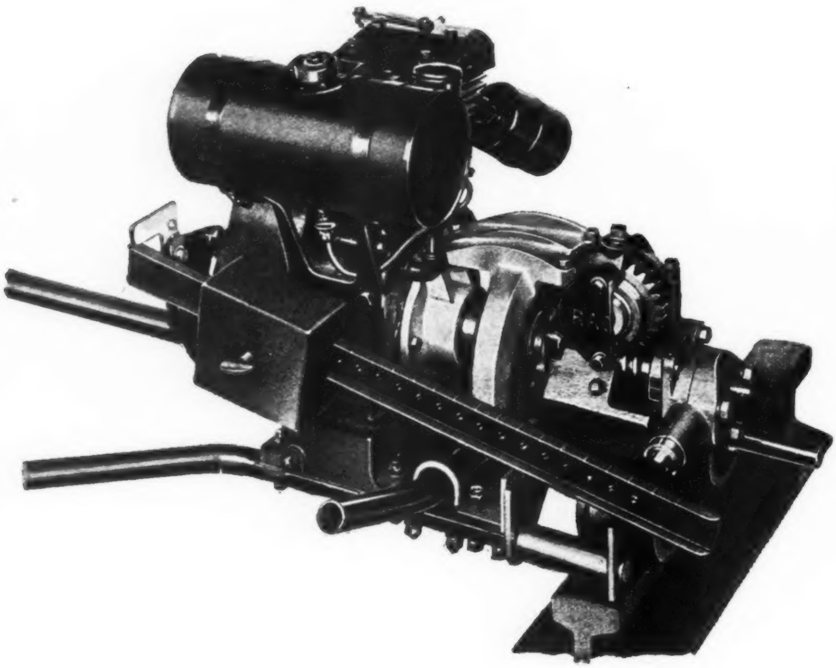
Atlanta, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Duluth, El Paso, Hartford, Knoxville, Los Angeles, Newark, New Orleans, Picher, Pittsburgh, Pottsville, Salt Lake City, Seattle, St. Louis, St. Paul, Tulsa

Fast



The most **mobile** machine is the **fastest.** Raco is the most easily handled, lightest, strongest–therefore **fastest.**

The new *Raco Micro Cutout*



insures that an exactly uniform power will be applied to every nut.

It is **accurate** to within 3%.

RAILROAD ACCESSORIES CORPORATION

Main Office

137 East 42nd Street

(Chrysler Building)

New York

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

SEATTLE
1038 Henry Bldg.

SAN FRANCISCO
550 Montgomery St.

LOS ANGELES
Union Bank Bldg.

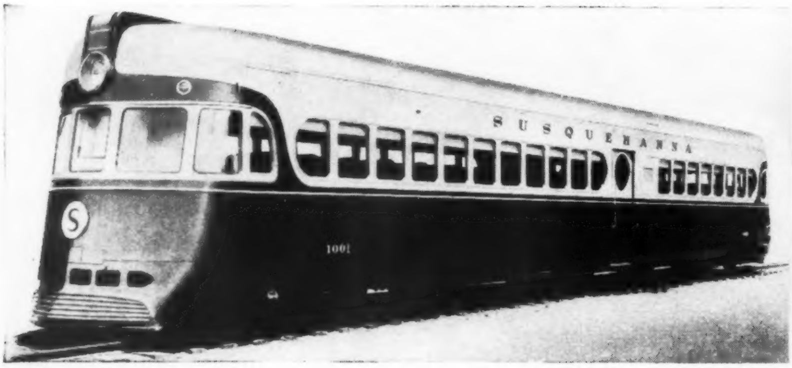
Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3, 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

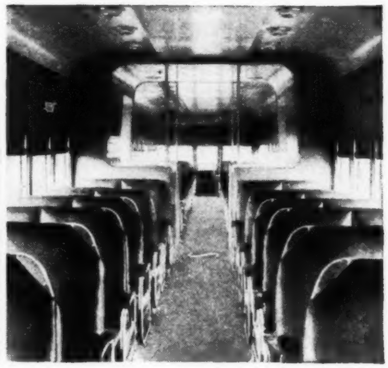
Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

PRINTED IN U.S.A.

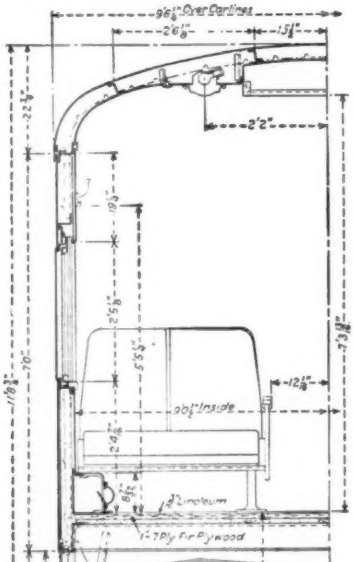
NOVEMBER, 1940

Douglas Fir Plywood Floor is Feature of New Susquehanna Rail Cars!





DURABLE BEAUTY The linoleum floor in the Susquehanna's new rail car (right) looks better and will wear better because the sub-floor is Douglas Fir Plywood.



Typical cross section

HOW USED This diagram shows how the 1-inch, 7-ply Douglas Fir Plywood floor was laid.

Large panels minimize joints . . . provide a perfect base for linoleum

The use of Douglas Fir Plywood flooring in the new New York, Susquehanna & Western rail cars is further proof of the versatility of this "modern miracle in wood." No other material could have provided the same strength, light weight, large size and satin smoothness at such low cost. But in the trend to lighter, faster, stronger passenger and freight cars, to streamlined stations and to more attractive concrete work, Douglas Fir Plywood is playing an increasingly important role. There is a type for every use . . . and every type is "grade trade-marked" for easy identification and specification. Learn now what Douglas Fir Plywood can do for you. Write Douglas Fir Plywood Assn., Tacoma Bldg., Tacoma, Wn., for any literature described below or for technical assistance.

STATION BUILDINGS PLYWALL builds puncture-proof walls and ceilings. 3/8" recommended, but economical 1/4" adequate for new construction or covering cracked plaster. 5/16" PLYSCORD recommended for wall sheathing. 5/16", 3/8" or 1/2", depending on rafter spacing and roof load, for roof decking under shingles, tile, composition roofing, etc. 1/2" or 5/8" for sub-flooring.

Specify PLYPANEL for finest paneling, cabinets, furniture and for partitions where both sides are exposed to view.

Specify EXT-DFPA for exterior siding of buildings, refrigerator cars and other uses where permanently waterproof plyboard is required. Bond between plies is impervious to moisture. 3/8" or 1/2" recommended. For more information, write for free Dri-Bilt Manual and Grade Use Guide.

CAR LINING 3/4" PLYPANEL (SO2S) most widely used for freight and baggage car lining. PLYFORM grade also popular. 5/16" PLYPANEL for ceilings. PLYPANEL (G1S or G2S) for fine paneling in passenger and dining cars. Write our Technical Division for specific recommendations.

CONCRETE FORMS PLYFORM, either 5/8" or 3/4", is ideal concrete form material. Gives numerous re-uses, satin-smooth surfaces. Free Concrete Form Manual contains full details.

DOUGLAS FIR PLYWOOD
Real Lumber
MADE LARGER, LIGHTER
SPLIT-PROOF
STRONGER

GENUINE DOUGLAS FIR PLYFORM Concrete Form Panel D F P A INSPECTED

GENUINE PLYWALL Douglas Fir Plywood WALLBOARD D F P A INSPECTED

SPECIFY DOUGLAS FIR PLYWOOD BY THESE "GRADE TRADE-MARKS"

PLYPANEL D.F.P.A.

EXT.-D.F.P.A.

GENUINE PLYSCORD SHEATHING D F P A

Railway Engineering and Maintenance

Human Interest

Lots of it in Railroading

TO the average railway employee who does his assigned work on the track or in the bridge gang day after day there is apt to come a time when he regards his work merely as a job, devoid of any special interest to others. Yet, if he will but look about him, he can soon find ample evidence that few other industries possess comparable appeal to the ambitious youth—and to his seniors as well.

Can he recall the days when, as a boy in a small town, the crowning event of his day was the arrival of the afternoon local, and how he hastened to the station to see it unload the boxes and barrels and set out stock and box cars for loading? Has he forgotten the thrill he received when the engineman in the locomotive cab waved to him and when the conductor on the station platform called him Bud? Does he remember how interested he was in the work of the section gang and how he dreamed of the day when he might also stand erect while his men pumped the hand car—how he might direct the gang in its work and flag a train to a stop?

Familiarity Dims Appreciation

If he no longer thinks of such activities as interesting, he has allowed his intimate association with these activities to dim his appreciation of the fact that the very nature of the activities of the railways, the precision with which they are conducted, the complete correlation of the work of many into a harmonious performance, the resilience of the organization in overcoming handicaps of weather and the elements, still challenge the admiration of others and lend romance to railway operation.

This widespread interest in the everyday work of the railways is illustrated so vividly by an article written by a lawyer in a small midwestern town and published in his community newspaper a few weeks ago that we are reproducing it in part here. It is taken from the Monroe County Democrat of Sparta, Wis., of August 30, and was stimulated by the manner in which two railways brought some 32,000 troops from seven states to summer maneuvers in that area late in August.

Did you ever stop to think that whenever we have something that we want done on time and done well, we turn it over to the boys on the railroads? Railroad men in whatever department are the pick of the manhood of the nation. They are trained soldiers, without marks on their sleeves or shoulders. They have discipline; the discipline of comradeship in which each does the job assigned to him. In this army of trained men, the conductor or the section boss or the superintendent doesn't need to carry a swagger stick, or to wear boots and spurs in order to command the respect of the men who take orders from him.

It was a pleasure to watch them working at both stations the Sunday and Monday that the troops arrived. Never in Sparta's history had there been so many passenger coaches in the North Western yards, or in the Milwaukee yards. Never had such heavy engines turned themselves on the wye tracks in each yard. Sometimes there were only inches to spare. Sometimes the curves were so sharp that the center driving wheels climbed the rails. But always they got the locomotives turned.

Spectators at the depots saw coaches from roads as remote as the Central Vermont, the Pere Marquette, the Grand Trunk, the New York Central, the Michigan Central, the Wabash, the B. & O., the Rock Island, the Pennsylvania, the Burlington, and I can't remember what others, being switched around and sent back home after having arrived with loads of soldiers.

And all of this these railroad crews did as a part of their daily work, without any grandstand play, without fuss or feathers, without any excitement and without even a cross word. Take off your hats to these veterans.

Opportunities for All

Always there will be romance for me in railroading, for I remember the boys who left my native village to go "brakin'." And I remember how they came home at Christmas time, no longer greenies but men of the world, sure of themselves. We could see they had been around, just from the way they walked.

And I remember the village boys and the farm boys who started on the section. Some of them got to be bridge carpenters and bridge foremen and bridge superintendents; and some of them got to be section bosses and roadmasters. What I liked about railroading as I saw it from the village and as I still see it, is that all the boys had a chance and the boy who would work and who had talents in one direction or another got ahead. Seldom did you see a son braking for a father who was a conductor; or a section hand working for a father who was the boss. There is less favoritism and more generous recognition of merit here than in any industry I know.

The railroads built this nation. We owe to them the wealth that our middle west and our far west have contributed. They have made our nation great; without them our nation will not continue to be great. Without them, with their reliability, their punctuality, their dependability, we cannot get along. It is time we stopped taking them for granted.

When the Blizzards Rage

Some night next winter when there are many feet of snow on the level, when the temperature is as low as it gets in Sparta, drop over to the Milwaukee depot and see No. 56 come in on time, pulled by two great locomotives to keep it on time. Or drop over to the North Western station and see No. 514 come in from the Black Hills, with a good coat of South Dakota snow and ice outside.

If No. 56 or No. 514 were abandoned; if you went over to either station to take one of those trains for Chicago and it didn't arrive; you would write a letter to the *Democrat;* you'd make a row that would be heard across the state. Yet if there is a sizable storm, your Chicago and Saint Paul-bound busses stop at Sparta or New Lisbon and coolly load their passengers onto one of the Hiawathas or onto the 400. And the railroads take these passengers, and, as usual, they deliver.

Appreciate the railroads. Remember they are your all-weather friends, not your fair-weather friends. Think back to the two days when the troops arrived in Sparta and ask yourself what Uncle Sam would have done without the railroads. Think of the mess we had on the highways because of the few troops that used them.

For heaven's sake, let the boys who now run the railroads continue to operate them. Keep the railroads away from Uncle Sam, or else he may shut up shop at six o'clock on Saturday night down at the Milwaukee and the North Western depots, just as he shut up the post office the Saturday night the troops and their parents and sweethearts were in town.

An Industry to be Proud Of

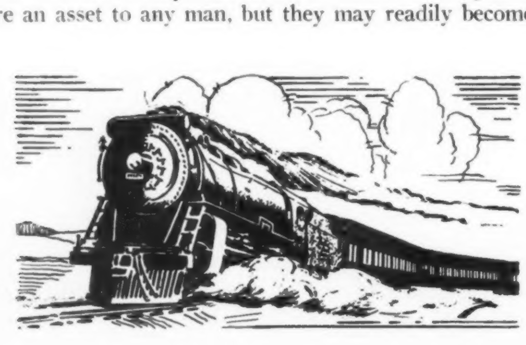
This is the railways that the thinking public sees—a vibrant organization rendering a high degree of public service. It is a picture that every railway employee should see—a picture that should create in him a keen sense of pride that he is a part of such an industry. It is a picture that he should pass on to others, that they, like this country lawyer, may appreciate the railways and see that they receive the treatment a generous public owes them.

The Committee Reports

Deserve Careful Thought and Study

IN the reports of committees presented before the conventions of the Roadmasters' and the Bridge and Building associations, maintenance of way officers have up-to-date treatises on at least 14 timely subjects relating to track, bridge and building and water service problems. These reports combine the knowledge and experience of practical men from railways in widely separated parts of the country, and reflect the standard practices and most advanced thinking of many roads, condensed, summarized and presented in a readable form.

No maintenance man need be told that these are changing days, with new problems being brought forward by higher train speeds, heavier wheel loads, increased traffic and ever-increasing demands for increased efficiency and economy. He may at any time be confronted suddenly with new problems in one or more of their many ramifications. Years of experience are an asset to any man, but they may readily become a handicap in these rapidly changing days unless he keeps abreast of new conditions and requirements and maintains an open mind. As pointed out by A. E. Perlman, engineer maintenance of way of the Denver & Rio Grande Western, in the address before the Roadmasters' convention in September, and published in this issue, "the railroad securing the best results will be the one on which the men work with open minds, receptive to the ideas of laborers, designers and shippers, and constantly alert to improvements emanating from other industries." Unquestionably, the same can be said of the results that will accrue to the individual who works with an open mind.



Painting

Important That Basic Rules Be Followed

IN general, the success of any operation depends on the observation of certain fundamental rules of procedure and, conversely, the violation of or failure to follow these rules is likely to bring failure to the enterprise. Painting is no exception. There are few operations in the building field that are so closely bound to formula as painting. A surface to be painted must be dry; it must be clean; if it has not been painted previously, it must be primed; if it has been painted previously, the requirements for cleaning, priming, etc., are definite and practically inflexible; and the composition and application of the several coats must follow a definite pattern if the results are to be satisfactory.

One of the fundamental and inflexible rules in painting is that every coat of paint applied to a surface, of either wood or metal, must be more elastic than the one that preceded it. The reason for this is simple, for linseed oil, the generally accepted vehicle for paints, does not dry as a result of the evaporation of volatile constituents, as most liquids do, but hardens by oxidation, the oxygen being absorbed from the atmosphere. This is a slow process that continues through the life of the paint, and results eventually in chalking as oxidation of the paint surface is completed. Obviously, the finishing coat, which is exposed directly to the air, absorbs the oxygen more rapidly than those below and hardens before the others are affected much. Assuming that the paint has been formulated correctly, the second or body coat will lose its elasticity in the same way before the priming coat does.

This raises the question of how the elasticity of the successive films of a paint coat can be varied, a subject about which there seems to be some confusion. In the first place, the hardness of the film will vary directly and the elasticity will vary inversely with the amount of pigment in the paint. It follows, therefore, that the priming coat should contain the greatest amount of pigment and that the ratio of pigment to vehicle should decrease progressively in the body and finishing coats.

If the priming coat is to be applied to a steel surface, the dried film will contain the same relative amount of pigment that was present when the paint was applied. If it is to be applied to a wood surface, the paint should be mixed with an excess of oil, since a considerable amount of the oil, ranging up to as much as 50 per cent,

will be absorbed by the wood, so that the relative content of pigment in the dried coat will be much greater than it was in the paint as mixed.

In general, the dried priming coat for both wood and steel surfaces should contain, by volume, about 40 per cent of pigment, and should be relatively hard. Since it is not desirable to create an abrupt change in hardness between the priming and body coats, the dried body film should contain about 36 to 37 per cent of pigment. This will make a paint that will require thinning with turpentine to make it brush easily. The finishing coat should be much more elastic than the body and priming coats, a pigment content of 25 to 30 per cent being satisfactory, making thinning unnecessary.

It should not be overlooked that an important item in assuring these differences in elasticity is the requirement that every paint film must be allowed to harden or set thoroughly before the succeeding coat is applied. If this is not done the finishing coat will harden through exposure to the air before the body coat has had an opportunity to do so, and the same thing will occur between the body and the priming coats. In any case where the correct order is reversed and the outer coats are permitted to become harder than those below them, as the underlying coats harden and shrink they will rupture the films overlaying them and the paint will have an alligatored surface, a preliminary to complete failure. It will thus be seen that in painting, as in many other items of work in the building field, it is desirable that rules that have been proved to be fundamental, be followed closely to avoid failure.

Advanced Programming

More Essential Now Than for Many Years

THE roadway, bridge and building and water service forces on most railways have long found it desirable to program their work well in advance of actual field operations and to advise the stores department of their requirements as early as possible to permit orderly purchases and insure against upset work schedules or delays to their field forces. This is no new practice on most roads, and the routine involved is familiar to most railway maintenance men, but it seems timely to point out that if this practice has been desirable in the past, when the stores department found little competition in industry for materials and could secure them upon minimum notice, it is increasingly important today, and promises to become even more so in the months immediately ahead when many of the plants and storehouses of industry will become congested with domestic and foreign defense orders, for which prior consideration will, unquestionably, be demanded.

If anyone doubts the difficulties which the present outlook suggests, he need only recall the situation that prevailed during the period when the United States was engaged in the World War, when many of the materials urgently needed by the railways for maintenance of way and structures were at a premium, and frequently obtainable only after protracted delays. In the case of most steel products, it was necessary to place orders at least 18 months in advance of expected delivery, and even then there was no assurance that demands could be met in full or on time.

There is no suggestion in the foregoing that the United States may again become involved in war, but as a country we are committed definitely to the building up of an adequate defense, and it is significant and to the point in this discussion, to note that the appropriations already made for carrying out our present defense program far exceed the expenditures made for defense and combat purposes during the World War. While industry as a whole is adapting itself rapidly to the new situation, it is not surprising that some railway officers are already viewing with concern the probability of material shortages, or at least protracted delays in receiving their requirements. Reflecting fear of this probability, unquestionably, are the earlier than usual placement of orders for next year's rail requirements by a number of roads, and the further fact that some roads are already 30 days ahead of normal in their purchases of certain other materials and supplies, and expect that even this margin will have to be increased still further.

Representatives of the steel companies have been urging for some time that the railways place their orders at the earliest date possible, with the expectation that orders in hand will be given special consideration if congestion develops as the result of large government demands. It has even been suggested that it will only be a short time before the government will be allocating the output of all steel mills in the country. . . . . And what has been said relative to steel products applies with much the same force to certain other products. In fact, difficulty is already being experienced in some quarters in securing prompt deliveries of certain classes of lumber and timber in the quantities desired, and it can well be anticipated that this trouble will increase.

What does all of this mean with respect to programming work? It means that if it has been considered desirable in the past for maintenance men to program their work well in advance of field operations to permit orderly and economical buying and to insure the delivery of equipment and materials when needed to avoid disrupting work schedules and causing costly delays, they must give greatly increased attention to programming their work in the days immediately ahead. And of equal importance, they must increase the range of the forecasts of their requirements furnished to the stores department. Where this has been on anything less than an annual basis, the period will, unquestionably, have to be extended, and even the practice of annual forecasts may prove inadequate to meet the situation on many roads. Furthermore, the whole present schedule of ordering materials from the stores department may have to be put on a greater time-interval basis, which brings the responsibility down to the supervisory officers in the field.

These are not pleasant prospects for maintenance men who are already carrying heavy responsibilities, and especially during a period when increased demands upon the tracks and structures are certain to call for enlarged work programs and increased needs for materials. But they are prospects which must be faced; they cannot be disregarded without seriously affecting maintenance operations, adequate maintenance of the fixed properties of the railways, and eventually, the very efficiency and safety of train operation as well.

With Tie Renewals the Largest Single Account in Maintenance of Way Expenses, They Offer Large Opportunities for Savings Through More Efficient Methods and Use of Mechanical Aids

Renewing 50,000,000 Ties a Year

By H. R. CLARKE

Engineer Maintenance of Way
Chicago, Burlington & Quincy

BECAUSE of the large expenditure involved, and the need for and possibility of reducing expense, the subject of tie renewals requires continued study, even at the risk of becoming tiresome. In addition to the cost of the ties themselves, the labor of renewing them has required a substantial portion of the time of our track forces for the last 100 years, and the combined cost of these two items, ties and the labor of handling them, has been and continues to be the largest single account in our maintenance of way expenses.

It cannot be said that no progress has been made in effecting economy in tie renewals. Very definitely, there has been progress, but it has been the result of better specifications for the purchase of ties and closer adherence to them, greater care in seasoning and handling, and, most of all, the development of and improvements in the art of timber preservation and the protection of ties from mechanical wear and damage. So far as the methods followed, the tools used, and the organization of forces employed in the actual renewal of ties, the change has not been marked and progress has not been great. It is in these latter things that we must now move forward, as a further reduction in the cost of handling our maintenance of way work is imperative, if for no other reason than to offset, if possible, the increased expenses that have been forced on us in other ways.

In a study of the subject of tie renewals, the logical first consideration is as to how we shall determine the ties that are to be renewed. The first responsibility for this should rest with the section foreman. In the fall, before the ground freezes, he should make an inspection and mark in some way, without damage to them, the ties that he thinks should be renewed the following season. A record should be made of the ties so marked, by miles. In multiple-track territory the tracks should be listed separately; yard and side tracks should be identified by number, name, or in some other definite way.

The track supervisor, roadmaster, division engineer, or other maintenance of way supervisory officer should then make such check on each section as will enable him to know that, in general at least, the ties marked by the foreman should be renewed in order to maintain the established track standard, modifying the foreman's estimate as he thinks necessary. The number of ties determined in this way will be used by the system maintenance officer in making up his tie program or budget, to be submitted for approval to the proper authority. Thus, the inspection made by the foreman becomes the basis for the shipping and unloading of ties for the season's tie renewal program.

Distributing Ties

The shipping and unloading of ties should be carefully planned and closely supervised to insure economy in handling and to avoid damage to the ties by unnecessary exposure. The source of supply, availability of equipment, tide of traffic, etc., vary so widely that the setting up of a definite practice for the handling and distributing of ties is not possible. We can, however, outline some general principles. If possible, ties should be allowed to dry or season for some time after treatment in large piles at treating yards before being shipped. This allows the free oil or creosote on the surface of the ties as they come from the retort, to drain off or to be absorbed. Ties so allowed to dry can be handled much more easily and with greater safety by the track forces

than can wet slippery ties, and the fouling of the ballast by oil exuding from them is reduced or avoided.

For both loading ties at the plant and unloading them in the field, open-top equipment is desirable, if available. Flat cars with end frames can be used to advantage when ties can be handled by work train, and when the haul is not too long. Gondola-type coal cars, with parts of the sides cut out, assigned to transporting ties from the treating plant to the track, are very serviceable.

The shipment of ties as needed, shortly in advance of their actual use, is ideal, but generally cannot be arranged for. When ties must be shipped some time in advance of their use, a desirable plan is to begin shipment in the late fall or early winter, after the season's work is practically done, unloading one car at each station on a section. This provides protection during the winter and spring and makes it possible to truck the ties by motor car and trailer in each direction as needed, without an excessive motor car haul. The additional ties required between stations should be unloaded, 30 to 50 in a place, using a work train or other available train service. Unless the ties are to be used in a short time, they should be piled neatly in small piles. This prevents excessive exuding of the oil and creosote, which occurs if the ties are exposed to the hot sun, and also reduces excessive checking of the ties, which would otherwise occur. Further advantages of this method of distributing ties are that the ties can be piled in such manner that they will not be in the way of other operations that must be carried on, and the right-of-way will present a much neater appearance. Furthermore, the ties can be distributed from these small piles, as needed, with the minimum amount of labor.

Considerations for Renewals

The preliminary inspection and marking of ties as made by the foreman should not be the final basis for actual renewals. It is difficult at times to determine the true condition of a tie without doing more work and spending more time than is justified in the preliminary check, and in some cases there may be an unexpected change in tie condition. In advance of actual renewals, therefore, another and closer inspection should be made

In this paper, presented before the convention of the Roadmasters and Maintenance of Way Association in Chicago on September 11, the author reviews the entire problem of tie renewals from the standpoint of the man in the field, discussing the basis for renewals, inspections, distribution, methods of making renewals, various organizations for doing the work, undesirable practices, and the large need for mechanical aids to reduce present costs

by the foreman in charge of the gang that is to do the work, and he should be held responsible for taking out only those ties that should be removed and for leaving in all ties that will give further service. The work of tie renewal gangs should be checked every day by some supervisory officer to insure utmost care and economy in the use of ties, and no ties removed should be burned or otherwise disposed of until inspected by the roadmaster or other designated officer.

To determine which ties are to come out, the foreman in charge of the work must know the basis on which renewals are being made—that is, annually or at longer intervals, and he must be familiar with the traffic demands on the line as to speed, axle loads and tonnage density, and know the standard of maintenance established. It is the responsibility of the roadmaster or other designated supervisory officer to see that foremen are thoroughly informed on these matters.

It is generally agreed, I believe, that when track is being surfaced out-of-face, ties should be renewed to the extent that no renewals will be required during the following year. The cost of digging in ties, compared with the cost of renewing them when track is being raised, is so much greater that the loss of a year's tie life is justified. There is the further advantage in this that the new ties will at once carry their share of the load if put in when the track is being surfaced, whereas it is almost impossible to tamp a tie, dug in, in such a way that it carries its full load when first renewed. Some maintenance officers believe that when surfacing, renewals should be made to such an extent that no further renewals will have to be made for a period of even longer than a year. I hesitate to concur in this opinion, and no such standard has been set upon the Burlington, as it might result in the misuse of ties. I am of the opinion, however, that if good judgment and care are used, renewals can be made, without waste, in such a way that it will be necessary to replace very few ties the second year after the track has been surfaced.

There is a greater difference of opinion as to the frequency of making renewals when ties are dug in. On some roads it is the practice to renew ties on part of a section, say one-half, every other year, and in a few cases renewals are made at three-year intervals. I prefer annual renewals, that is, working over the entire section or line each year, replacing such ties as should come out. I believe that this method results in the longest tie life and consequently greatest economy in the use of ties, and also that it produces more uniform tie and track conditions.

In any case, and regardless of the renewal basis, it is a decided mistake on high-speed, heavy-traffic lines to continue the practice that was once

There Is a Large Field for Devices to Reduce the Cost of Spot Tie Renewals, But, the Author says—"The Savings Must Be Actual, Not Theoretical"

generally followed, of making what might be called partial renewals; that is, putting in one new tie and leaving a decidedly bad tie on one or perhaps both sides of it. All ties, of course, cannot be equally good, but it is false economy to leave in ties so rotten or otherwise weak that they do not carry some load. Such spotted renewals result in choppy, poor-riding track under our present high speeds. Furthermore, under these speeds and present axle loads, a new tie, with rotten ties on each side of it, will crush, and possibly break, and its service life will be greatly reduced as compared with that secured where the ties are maintained to a more uniform condition.

Methods of Renewal

When ties are being renewed in connection with the resurfacing or ballasting of track, no special methods or equipment are required. Under these conditions, the track is almost always lifted and the ballast is loosened to such an extent that the old ties can be pulled out and the new ones put in without difficulty. At just what place in the progress of the work the tie renewals should be made will depend upon the extent of the work being done. If the track is being skeletonized in advance of the raise, it is good practice to renew and respace the ties just behind the gang that is digging out ballast, and before the new ballast is unloaded. In cases where the track is being resurfaced without digging out the old ballast, the ties should be renewed and respaced between the jacks and the tampers. The exception to this is, of course, those ties that are to be tamped at the jacks, which should be renewed and respaced, if needed, after the track has been lifted, but before they have been tamped. While it is desirable to renew ties wherever possible when surfacing track, naturally only a comparatively small percentage of the total can be inserted in this way.

For making tie renewals by digging them in, there is a difference of opinion as to the organization and methods that should be used. If renewals are light, not more than 75 to the mile, and comparatively scattered, the work should be done by section forces, as a section gang consisting of a foreman and three men, which is almost the minimum force practical during the working season, can renew at least that number of ties and still take care of other necessary work. When renewals are heavy, a special tie gang is justified, this gang to be moved from place to place as needed to supplement the work of the section forces.

Early in my remarks I suggested there had been no great change in the organization, methods or tools used in making the renewals. The only change in organization has been the use of special gangs to supplement section forces where justified. There has been no great change in the method of doing the work. The general practice still is to dig out the crib alongside the tie to be renewed to a depth slightly below the tie bed, then to knock or force the old tie from its bed into this depression, and finally to pull it from beneath the rails. To permit dislodging the old tie more easily, the rails are usually lifted slightly, either with a track jack or bar, care being used not to lift the track to such an extent that ballast might work under the lifted ties and thus cause rough track. The tie bed is then cut down as may be necessary to accommodate the new tie and plate, and the new tie is put in and tamped up as solidly as possible against the rail. Usually, one or more trains are allowed to pass, if this can be done, before the tie plate is applied. On most roads, rules require that tie plates be placed and all ties be full spiked before quitting work for the day. Also, that not more than a single tie in a place be left unspiked, unless speed is restricted. In some cases there are further instructions as to the number of ties in a panel that may be left unspiked. All of these are wise precautions.

The extent to which jacks are used to reduce the amount of digging required to remove old ties and insert new ones depends upon the importance of the line involved with respect to speed and density of traffic, kind of ballast, etc. On high-speed lines the general practice is to lift the track only slightly, if at all, while on branch lines where speeds are not so great and maintenance of perfect surface is not so important, the jack is used more freely. A good trackman is careful at all times not to cut down the solidly packed tie bed more than is actually needed to permit placing the new tie. To do otherwise, increases the work to be done and, in addition, results in a less solidly tamped tie after the job is finished.

Mechanical Aids Considered

I have said that the progress that has been made in the development of new tools has not been great. I think this statement is correct, but it does not follow that no effort has been made. For at least 20 years, and probably even longer, so-called tie pullers have been offered to the railways from time to time. During the last two or three years there has been increased interest in such a device. There are now at least four tie pullers being offered by manufacturers who have spent considerable time and money in an effort to develop a tool that will be accepted and used. The railroads have co-operated by trying all of these under actual working conditions. All of these devices will pull a tie out of track with the necessity for removing little, if any, ballast in advance. Some operate more efficiently than others, but, unfortunately, so far all have one defect in common—their use does not greatly reduce the cost of renewing ties, if at all. I make this statement based on data that have been developed on my own road and supplemented by such information as I have from other roads. I am on record as having said many years ago that such a device was needed, and that when developed, the railroads would use it, if they found that by so doing economies could be effected. The saving must be actual, not theoretical.

Another tool developed recently which is used to some extent in removing ties and which does reduce the cost of the work is the tie saw. It is not used extensively as yet and the objections to it are high first cost, high cost of maintenance, the fouling of ballast with sawdust, and the destruction of the tie removed, making it unfit for further use of any kind, except for fuel. I do not consider the last two objections as of great importance, but the first two mentioned are.

The first cost of these machines is such that they cannot be assigned to individual sections; they must be used with tie gangs. Where renewals are made by section forces, the saving cannot be realized, and the assignment of tie gangs under present force allotments is not always possible. I still hope and believe that, ultimately, both the tie puller and the tie saw will come into more general use. I still go on record as saying that such devices are needed and will be used if they save the railroads money.

Another machine that has been worked out with a great deal of care and detail is used to cut down the tie bed to the desired depth after the old tie has been removed. It operates quite well in some kinds of ballast, but it is doubtful if it would be effective in crushed rock, slag or heavy gravel. It is being used quite extensively by the road on which it was developed, but has not come into general use. Like the saw mentioned previously, it cannot be used economically with a small force.

Up to this point, I have not mentioned the need for care and proper handling at all times to prevent damage to ties and consequent premature decay. It was not in the assignment given me, but I cannot close this discussion without mention of this most

(Continued on page 734)

The Railways Have Invested Millions of Dollars in Modern Types of Work Equipment to Effect "Results" in Track and Bridge and Building Work

It's Results That Count

By A. E. PERLMAN

Engineer Maintenance of Way
Denver & Rio Grande Western
Denver, Colo.

THE operating expenditures for maintenance of way and structures during the years 1920 through 1929 amounted to more than eight billion dollars. In the last ten years, you have cut these expenditures very nearly in half. Statisticians would say that this reduction was accomplished only through deferring a large portion of your work. Many of them believe that the railroads are slow to change, are encumbered by tradition, and are hopelessly outmoded. On the contrary, I have no fear in saying to you that the railroads today are in better shape to handle their traffic at higher speeds than they were ten years ago. The speeds of freight and passenger trains and the railroad safety records bear witness to this statement. If these people could make an intimate study of your properties on the ground rather than basing their conclusions on statistics, they would find revolutionary changes written in the timber and steel and earth on every inch of the properties you maintain. But we, in our secure knowledge of what has been done, have not been very articulate; we merely say, "It's results that count," and never fully explain to the public the magnitude of these results. Let me review briefly some of these results which are so clearly found in studying the men, methods and materials on our railroads today.

Many Results

Today, in picking the men who will some day replace us, it is not a relative or friend who receives first consideration; it is the man who passes the best test for physical and mental fitness, whose background of education and experience has been fully investigated. He is given a thorough apprenticeship to insure proper knowledge of modern methods and machinery. He is taught to plan his work and to co-operate with his associates. Underlying principles as well as their practical applications are taught him. As he progresses, he is given an understudy to train so that he will have some one to fill his place when he is promoted. The "boomers" of yesterday have been replaced by craftsmen who do credit to the railroad industry and to the communities in which they live. In an industry as far-flung as ours, where almost half of every revenue dollar is spent for labor, we must have men with initiative, but properly trained so that that initiative is not misdirected.

In this paper, which was presented before the Roadmasters' and Maintenance of Way Association convention in Chicago on September 11, the author reviews with some satisfaction the achievements in maintenance of way standards and practices during recent years, but cautions that there is much yet to be achieved, and that it is that railway whose men have open, receptive minds to new ideas that will secure the greatest results in the future

Expenditures are budgeted and work is programmed, thus stabilizing employment. Seasonal operations are planned to take advantage of the economies found in doing work with the least possible interruptions from traffic. While the maintenance ratio appears high in the spring when rail is relaid during periods of light traffic, the actual dollar savings to the railroad in this practice are substantial. And to the credit of progressive railroad management, let it be said that they would rather save the dollar at the end of the year than have the satisfaction of a good record on paper during certain months.

Improved Machines and Materials

Machine methods have added to the safety, economy and efficiency of this programming. We have heard much of the Ford assembly line, but the mechanized steel gang, with machines for taking out the old bolts,

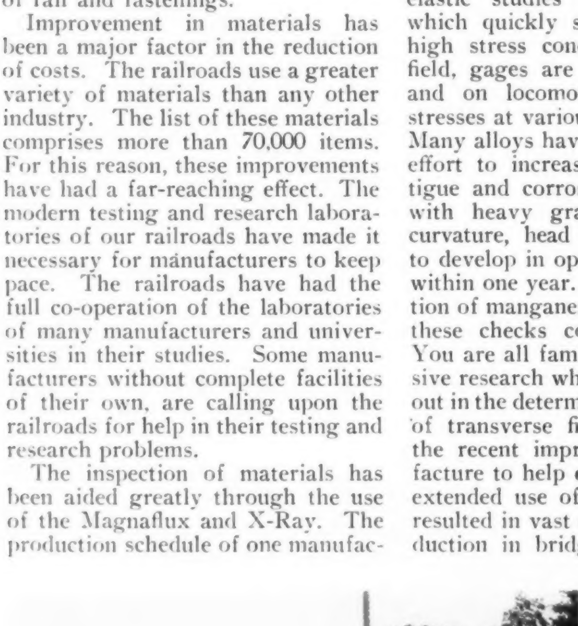
pulling the spikes, throwing out the rail, adzing the ties, placing the new rail and bolts, and driving the new spikes, is as minutely organized to do a job in the field as is the assembly line in the factory. The power drills, with which gangs are equipped can perform more work in an hour than can be accomplished in a day using a hand drill. The steam ditchers, clamshell buckets and spreaders, used with work trains are being replaced by crawler-type equipment which can do the work without interference with train service and at from one-quarter to one-half the cost. On one railroad, an investment of $90,000 in this type of equipment four years ago has returned a saving of more than a quarter of a million dollars annually. In the Twenties, we spoke of the savings derived through the use of motor cars, which replaced hand cars. Today, track motor cars are being replaced rapidly by motor trucks which can increase the radius of operation safely to at least three times the distance. Machines are being used to renew old ties and to tamp new ties. Welding practices are adding substantially to the life of rail and fastenings.

Improvement in materials has been a major factor in the reduction of costs. The railroads use a greater variety of materials than any other industry. The list of these materials comprises more than 70,000 items. For this reason, these improvements have had a far-reaching effect. The modern testing and research laboratories of our railroads have made it necessary for manufacturers to keep pace. The railroads have had the full co-operation of the laboratories of many manufacturers and universities in their studies. Some manufacturers without complete facilities of their own, are calling upon the railroads for help in their testing and research problems.

The inspection of materials has been aided greatly through the use of the Magnaflux and X-Ray. The production schedule of one manufacturer was nearly disrupted when a railroad inspector brought in a portable Magnaflux which showed laminations in the fireboxes of new locomotives which were ready to be shipped to his road. Needless to say, that manufacturer now has more modern methods of inspection. In another instance, a jobber bid on a carload of roofing; he submitted samples which were rejected by the railroad's testing department. Very indignantly, he told the railroad purchasing agent, "You've purchased material from another jobber who buys his felt from the same manufacturer from whom I buy. You must have other reasons for not accepting my roofing." The jobber checked the railroad's tests at a commercial laboratory and found to his surprise that he was getting sweepings rather than first-grade felt. The materials that he now purchases are carefully tested.

Research and Tests Extended

Rail and fastenings have been given searching study to secure improved design and longer life. Design has been assisted by photo-elastic studies in the laboratory which quickly show the points of high stress concentration. In the field, gages are used on the track and on locomotives to determine stresses at various speeds and loads. Many alloys have been studied in an effort to increase resistance to fatigue and corrosion. On railroads with heavy grades and extensive curvature, head checks were found to develop in open-hearth steel rails within one year. Through the addition of manganese, it was found that these checks could be eliminated. You are all familiar with the extensive research which has been carried out in the determination of the causes of transverse fissures, resulting in the recent improvements in manufacture to help eliminate them. The extended use of treated timber has resulted in vast economies, and a reduction in bridge maintenance has resulted from the recent development of corrugated metal pipe of larger diameter than available heretofore.



"The Mechanized Steel Gang—Is as Minutely Organized to Do a Job in the Field as Is the Assembly Line in the Factory"

Must Keep Open Minds

These are some of the results achieved during the last decade. What of the next? How can we continue to make progress? First again, men must be considered, for it is men who adopt the new methods and materials. Through the co-ordination of effort of men in the field, office and laboratory will come the perfection of methods and materials, superior to any we have ever known.

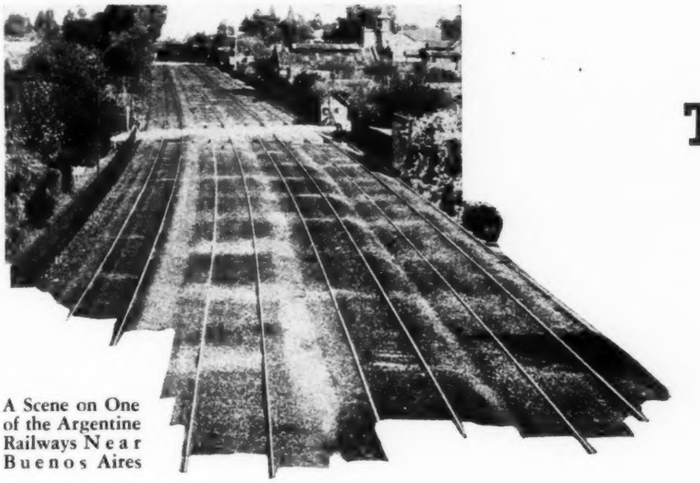
I keep ever at hand the concluding paragraph of the book by Dorsey, "Why We Behave Like Human Beings." It reads in part, as follows:

"The human being that can learn no more has parted with the only priceless possession in human inheritance. The men, women or nations that harden in their mold, get set in their ways—such men, women or nations are old; decay is at hand. They forget how they learned to behave like human beings and how life itself in human beings renews its youth and speeds up the race for freedom—as a little child, with an open mind."

I speak feelingly in this regard for there are always inhibitions and inertia to overcome. It is easy for one to sit back in a satisfied manner and say, "We've done a good job"; but in the transportation industry, as in all others, it is a matter of the survival of the fittest. We must either improve our operations or slip backward. The railroad getting the best results will be the one on which the men work with open minds, receptive to the ideas of laborers, designers or shippers, and constantly alert to improvements emanating from other industries. A "Steinmetz" or a "Kettering" is a great asset to a company, but their value would be nullified if their ideas are not translated into action by others.

It is results that count, and subsidized competition has never yet matched your ingenuity. To keep faith then, with this industry that we all love so well, let us seek to continue through the next decade the amazing progress of the years just past. Let us keep the railroads dominant in transportation and in the progress of all American industry. Let each of us add his bit, whether it be a better method of tamping a tie, an improved rail fastening, or the more patient and painstaking training of an understudy. Then, in 1950, with the railroads still on top, we can all say, "I've done my share."

Track Inspector System Works in The Argentine



A Scene on One of the Argentine Railways Near Buenos Aires

By F. L. CRESWELL,

Engineer-in-Chief, Buenos Aires Great Southern and Buenos Aires Western Railways

THE Southern and Western railways of Argentine (including the Bahia Blanca North Western railway which is operated under agreement by the Southern railway) have a combined route kilometrage of 11,267 (7,001 miles) and serve an area of approximately 450,000 sq. kilometres (173,800 sq. mi.) located for the major part in the central plains of the Argentine Republic.

Traffic conditions vary widely between the limits of the heavily-worked electrified suburban lines in and around Buenos Aires, and the far flung branch lines which traverse sparsely populated areas and carry but a few trains weekly.

Track construction involves a number of types of rail, all flat-bottom, ranging from 100 lb. down to 56 lb. Ties are generally of South American "red quebracho," an extremely hard wood, which, when not directly exposed to the sun's rays, has a probable life of 50 to 60 years in main line and subsequently in sidings. The rails are spiked directly to the ties, chairs being employed only on the electrified suburban lines and certain curves on unelectrified suburban lines. There are also between 2,000 and 3,000 kilometres (1,200 to 1,800 miles) of track laid on steel ties, and some of the less important branch lines consist of light section rails laid on cast iron pots with transverse wrought iron bars to maintain the gage. Ballast also varies between such materials as broken graded granite, gravel, petrified shell and cinders, while many thousands of kilometres of track are unballasted.

Old Organization

Previous to 1932, track maintenance was done by small section gangs composed of a foreman and from 5 to 10 laborers located at almost every station throughout the system, and each covering from 10 to 20 kilometres (6¼ to 12½ miles) of track. As a means of transport, these gangs were equipped with either an ordinary hand car or a horse drawn car. Floating gangs of 15 to 20 men handled the heavier items of track maintenance, and were housed in unserviceable cars and coaches that were not fit for revenue service and that were moved from station to station as their work demanded.

Prompted by the description of the track supervisor system as employed on the Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific, which appeared in the April, 1940 issue of *Railway Engineering and Maintenance*, Mr. Creswell sent this description of the track inspector system on the roads under his direction in the Argentine to the chief maintenance officers of the above roads. Introduced at about the same time, it is significant that the systems followed there and here are strikingly similar—and are accomplishing much the same results

Direct supervision over maintenance was generally effected by track inspectors, each controlling an average of 200 kilometres (124 miles) of track; these inspectors reported to the sectional engineers who on an average were responsible for the maintenance of 596 kilometres (370 miles) of lines.

Radical Change

In 1932 a radical change was made in the organization of the maintenance forces, and immediately thereafter the small section gangs outside suburban zones were replaced by fewer gangs of increased size, each equipped with a motor car and trailer and operating over a considerably extended territory.

The following comparisons between conditions (exclusive of suburban sections) prior to the change, and at the present time, will give at a glance an idea of what was accomplished:

	Kilometres	Miles
No. of section gangs prior to 1932	733	
No. of section gangs, 1940	197	
Average length of gang section prior to 1932	16	10
Average length of gang section, 1940	60	37¼
Maximum length of gang section prior to 1932	25	15½
Maximum length of gang section, 1940	120	74½

With the introduction of motor-

ized transport and the corresponding reduction in the number of gangs, it was found that the effective production of work was greatly stepped up as the percentage of foremen, cooks and other non-productive units in relation to the total strength of the track forces was appreciably reduced. Moreover, the increase in strength of each individual gang contributed to the more efficient manner in which maintenance work was done, and in spite of the very considerable increase in the length of the sections, the provision of motor transport not only reduced traveling time, but enabled the men to arrive fresh at the work, instead of tired, as was the case when hand cars were used.

As far as possible the headquarters of each gang was arranged near the center of its section, preference being given to stations where schools, medical and other facilities were available.

The net result of the increased efficiency obtained can be more easily appreciated by reference to the following figures:

Total strength of track forces 1931	6100
Total strength of track forces 1940	3855
Percentage reduction in 1940 as compared with 1931	36.8

It should be noted that during this period the total mileage of the system has remained approximately constant while the standard of maintenance of the tracks has been considerably improved.

Training and Supervision

Concurrently with this reorganization, and with a view to improving the knowledge of track foreman and unifying their methods of working, a training center was established for maintenance of way forces, where all grades of supervisory officers were given intensive courses of instruction and training in standard maintenance methods. Thus it is now possible to travel over the whole system and observe that each gang is doing its work in a uniform manner.

In 1937 it was felt that a further improvement in supervision was necessary with a view to increasing track patrol without diverting the gangs from their all-important duties of programmed progressive track repair and to secure a better co-ordination of work. To this end it was decided to decrease the number of permanent way inspectors and introduce supervisors to rank between the gang foreman and the remaining inspectors, and during the succeeding years this modification in supervision has been introduced practically throughout the whole system.

With the present arrangement an engineer in charge of a district has under his jurisdiction an average of 838 kilometres (521 miles) of track, with one permanent way inspector whose duties are to co-ordinate the work of, in general, three supervisors, advise them as may be necessary, and supervise working programs, etc. The average number of gangs directly controlled by each supervisor, exclusive of suburban sections, is four, covering an average territory of 273 kilometres (170 miles) of track.

Duties of Supervisors

The supervisors are stationed at strategic points in respect to the territory under their jurisdiction, and their duties are to make systematic patrols of tracks (the frequency of the patrol varying according to the importance of the tracks) to check the working efficiency of the gangs under their control, and to prepare and insure the progress of all programs of work. They are supplied with light two-seated motor cars for their patrol work, and in order to enable them to spend as much time as possible on this, their most important duty, they have been relieved almost entirely from administrative duties and correspondence. The responsibility for the maintenance of each section rests, as previously, with the foreman, but under this new organization the programmed work of the gang is only interrupted to carry out emergency track patrols, and never for the purpose of ordinary routine patrols.

It will be noted that the introduction of supervisors in our maintenance organization has been evolved as a natural consequence of the reorganization of the gang distribution, which in itself was developed as a measure of economy made necessary by reduced earnings. The considerable reduction in track forces called for some method of increasing the efficiency of those remaining, if the standard of maintenance was to be upheld, which could only be brought about by modernizing the methods of working, programming the normal maintenance work, improving the supervision, and relieving the gangs from routine patrol work.

The track supervisor system which we have evolved to cope with these requirements has amply justified itself and demonstrates an increase of efficiency over previous methods of working by enabling somewhat higher standards of maintenance to be reached, while at the same time greatly reducing the overall maintenance costs.

Renewing 50,000,000 Ties

(Continued from page 730)

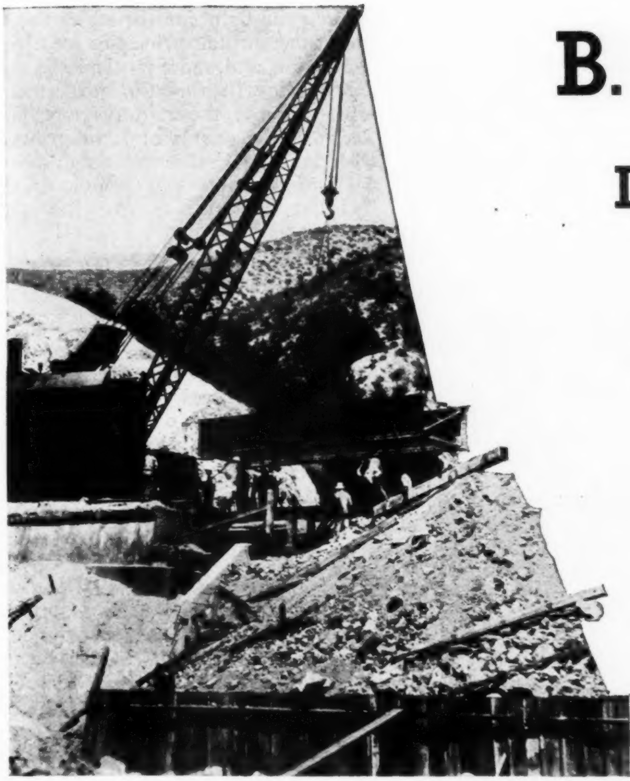
important factor in tie economy. Every competent trackman knows the rules for proper handling of ties and is fully aware of the savings that result if these rules are followed.

Repeating the statement made previously, we must find more efficient and, consequently, more economical methods of handling all classes of maintenance of way work. It may be difficult to mechanize renewals, but it will be done. Perhaps the solution is in the development of two devices, one for use with larger gangs and another for section forces. The first might be somewhat expensive in both first cost and maintenance, but for section use the machine must be simple, almost fool-proof, and low in cost. In either case, to be accepted and used, the final result must be a reduced cost, all factors considered.

Discussion

Most of a rather long discussion that followed the presentation of this paper consisted of questions that were directed at Mr. Clarke for the purpose of expanding certain parts of his paper. The first related to the liberality that should be displayed in renewing ties in connection with general surfacing, compared with spot renewals. The answer was that this will depend to a considerable extent upon the policy of the road, but principally on the value left in the tie compared with the cost of a spot renewal later. Mr. Clarke indicated that, generally, it will cost about the same to leave a tie in the track, if it has only two years of service life remaining, as it will to renew it in connection with the general surfacing, while the cost of removing a tie that has only one year of life will be about one-half of the cost to leave it in.

Several members sought information concerning the cost and relative advantages of 9-ft. ties. Mr. Clarke replied that since 9-ft. ties have not been used for longer than a few months, their advantages are as yet entirely speculative, but that the Atchison, Topeka & Santa Fe, which has gone to ties of this length, became fully convinced of their advantages after an exhaustive study of the subject. C. W. Baldridge (A.T. & S.F.) stated that since logs are cut in mill lengths of even feet which increase by increments of 2 ft., the 9-ft. sawn tie does not cost any more than the 8-ft. 6-in. tie, although a small premium is paid for the longer hewn ties.



Proper Equipment is Essential to Efficient Bridge Work

B. & B. Officers Dig Into Problems At Convention

This is a running report of the forty-seventh annual meeting of the American Railway Bridge and Building Association, held at Chicago on October 15-17, where 239 railway bridge, building and water service men from many parts of the United States and Canada gave detailed consideration to five addresses and eight technical reports on widely diversified subjects relating to their work, and viewed an exhibit of bridge and building equipment and materials

CLIMAXING another year's work, the American Railway Bridge and Building Association held its forty-seventh annual convention at the Hotel Stevens, Chicago, on October 15-17—a meeting which, with a well-rounded program, including five addresses and eight committee reports on subjects of timely interest to bridge, building and water service men, as well as a number of special features, was characterized by intense interest and unusually active discussion. Altogether, 239 railway men from the United States and Canada registered their attendance and took part in the meeting, the value of which was enhanced materially by a concurrent exhibit of bridge, building and water service equipment and supplies, presented in an adjoining area by the Bridge and Building Supply Men's Association.

The convention, all sessions of which were presided over by A. E. Bechtelheimer, president of the association, and assistant engineer of bridges of the Chicago and North Western, was opened by C. E. Johnston, chairman Western Association of Railway Executives, who welcomed the association to Chicago and urged its members to guard jealously the fundamental principles upon which this country was founded. Other addresses were made by Otto Kuhler, consulting designer, New York, on Streamlining the Smaller Passenger Stations, and by H. R. Duncan, superintendent of timber preservation, Chicago, Burlington & Quincy, who spoke on How Bridge and Building Officers Can Co-Operate with the Purchasing and Stores Department in Protecting Their Material Requirements. Technical reports were presented on The Mechanization of Bridge and Building Forces; The Detection and Elimination of Termites in Railway Structures; The Inspection of Buildings to Formulate the Maintenance Program; Protecting Steel Structures from Severe Corrosion; The Repair and Renewal of Ballasted-Deck Bridges; The Adjustment of Locomotive Watering Facilities to Larger Tenders and High-Speed Trains; The Heating of Locomotive Terminal and Shop Buildings; and The Storage and Delivery of Bridge and Building Materials.

Special Features

Special features of the program included an evening session on Tuesday, at which Geo. W. Rear, bridge engineer, Southern Pacific, Pacific Lines, presented an illustrated talk on The Bridges on the Shasta Line Diversion of the Southern Pacific; the annual luncheon on Wednesday, with 212 members and guests in attendance, who were addressed by Bruce E. Dwinell, general counsel, Chicago, Rock Island & Pacific; the annual dinner on Wednesday night, jointly with members of the Bridge and Building Supply Men's Association, which was attended by 183; and a trip to the system storehouse of the Chicago, Burlington & Quincy, at Aurora, Ill., and its reclamation plant at Eola, Ill., on Thursday afternoon, where members were given an opportunity to observe the manner in which materials are assembled, stored, scrapped or reclaimed, and distributed at these points. Still another feature of the program was a period set aside in the session on Wednesday afternoon to honor the memory of C. A. Lichty, secretary of the association for more than 30 years, who died on April 18. At this time, with past-president Elmer T. Howson presiding, tribute was paid by J. P. Wood, supervisor of bridges, buildings and water service, Pere Marquette, (retired); Armstrong Chinn, chief engineer of the Alton, and George Rear, all past presidents of the association, and by Tom Lehon, president of the Lehon Company, and a past president of the Bridge and

Building Supply Men's Association.

Lending support to the association, three committees of the American Railway Engineering Association and the Executive committee of the American Wood-Preservers' Association, held meetings in Chicago during the convention. The A.R.E.A. committees which met were those on Wood Bridges and Trestles, Buildings and Wood Preservation.

H. M. Church Elected President

In the election of officers for the ensuing year, H. M. Church, general supervisor bridges and buildings, Chesapeake & Ohio, Richmond, Va., was advanced from second vice-president to president; R. E. Dove, assistant engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago, was advanced from third vice-president to first vice-president; F. H. Soothill, chief estimator, Illinois Central, Chicago, was advanced from fourth vice-president to second vice-president; G. S. Crites, division engineer, Baltimore & Ohio, Punxsutawney, Pa., was elected third vice-president; and A. M. Knowles, assistant engineer structures, Erie, Cleveland, Ohio, and a director of the association, was elected fourth vice-president. F. O. Whiteman, Chicago, and F. E. Wiese, chief clerk to the chief engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago, who were appointed secretary and treasurer, respectively, during the year by the Executive Committee to fill the vacancies created by the death of C. A. Lichty, who had held both positions, were elected secretary and treasurer, respectively.

Three new directors were also elected to serve for two years: R. E. Caudle, assistant engineer structures, Missouri Pacific Lines, Houston, Tex.; I. A. Moore, supervisor bridges and buildings, Chicago & Eastern Illinois, Danville, Ill.; and W. A. Sweet, general foreman bridges and buildings, Atchison, Topeka & Santa Fe, Newton, Kan. In addition, Neal D. Howard, managing editor, *Railway Engineering and Maintenance*, Chicago, was elected a director for a term of one year, to fill the vacancy created by the advancement of Mr. Knowles to fourth vice-president.

The secretary's report showed that, including 56 new members who joined during the year, there are 610 members of the association in good standing. Chicago was selected as the 1941 convention city. The subjects selected for study by committees during the ensuing year are: The Possibilities of Off-Track Equipment in Bridge Construction and Maintenance; The Maintenance and Repair of Bridge and Building Work Equipment; Protection of Bridges and Roadway from River Bank Erosion; Welding in Water Service; Wearing Surfaces for Building Floors, Platforms and Roadways; Modernizing Small Stations to Meet Present-Day Requirements; Efficient Methods of Transporting Bridge and Building and Water Service Gangs; and Recent Developments in Paint Removal.

A. E. Bechtelheimer
President

As bridge draftsman, assistant general bridge inspector, and general bridge inspector on the Chicago & North Western for 17 years, and for the last 12 years assistant engineer of bridges of this road, Mr. Bechtelheimer has had wide experience in all phases of bridge construction and maintenance. He has been a member of the Bridge and Building Association since 1920.

Following are all of the committee reports, with abstracts of the discussions which followed their presentation, as well as abstracts of addresses by Messrs. Johnston and Dwinell, and of greetings extended by Geo. S. Fanning and J. J. Clutz, presidents, respectively, of the American Railway Engineering Association and the Roadmasters' Association. The addresses by Messrs. Kuhler, Duncan and Rear will appear in later issues.

C. E. Johnston Opens Meeting

In his opening address, C. E. Johnston, chairman of the Western Association of Railway Executives, expressed his high regard for and his confidence in the work of the association, but called upon its members to join the fight for the retention of the fundamental principles of free enterprise, and, more particularly, the fight against the threat of government ownership of the railways and unreasonable demands of labor groups. Relative to his concern for the safety and continuance of fundamental American institutions, Mr. Johnston said, in part:

"We are living in an altogether different world today, as compared with 25 or 30 years ago. This does not mean—this cannot mean, that we are to substitute fundamentals which will change entirely the American way of life, without jeopardizing our very liberty and freedom. We all know well that we do not long get something for nothing; that we cannot spend ourselves out of debt; and that we cannot expect much unless we work for it. Still, we sit complacently by day after day and watch our politicians operate in a fashion that cannot but ultimately cause a serious change in, if not wholly destroy, our American way of life as handed down by our forefathers."

Citing several examples to this point, Mr. Johnston saw in bridge and building gangs, and especially in the pile-driver crew, the kind of initiative which we need in the United States. "The typical pile-driver crew in the bridge and building department of our railways," he said, "generally exemplifies the true American spirit of initiative and freedom, which, when properly organized, is capable of great accomplishments. In fact, with the proper initiative and freedom, there appears to be no limitations to our achievements."

Need Unity of Purpose

Turning to the matter of labor relations, Mr. Johnston decried the socialistic trend in this country and called for greater unity of purpose between management and employees. "The character of the relationship between these forces," he said, "spells success or failure, profit or loss, peace or turmoil. We need not only unity in organization, but unity in purpose. Sad to relate, we have those in our ranks who, by their acts or sympathies with outside forces, seek, knowingly or otherwise, to destroy the fundamentals of free enterprise. This is disloyalty in its worst form, not only to our industry, but also to our republic. Organized labor in its true sense means organization for mutual cooperative benefit. We certainly have no quarrel about collective bargaining. We agree that labor should have every consideration in the way of satisfactory working conditions and rates of pay. As a matter of fact, we

spend much time and thought to bring about all of these advantages in favor of labor. We are, however, strongly opposed to the operation of labor unions for the benefit of unscrupulous racketeers who promote strife in their own self interest, at the expense of their members."

Cautioning that we are constantly confronted with the threat of government ownership and operation of our railways, Mr. Johnston spoke at some length relative to the unfavorable situation that has prevailed on the National Railways of Mexico since 1937, when the Mexican government expropriated that property and turned its management over to the labor unions. "Notwithstanding the fact that the Mexican government owns the railways (approximately 8,400 miles)," he said, "which I assume means no payment of taxes or interest on investment, the total deficit from operations alone for less than the three-year period to February 15, 1940, which must be paid out of the public treasury, was 23,000,000 pesos (approximately $4,700,000). This brings home to us what could happen here in this country under government ownership. Even if the management of our railways were not turned over directly to the labor unions, the administration would most likely be political, and with similar results as to deficits of operation.

"Our railroad system was built upon the foundation of freedom, under one 'ism'—and that is 'Americanism'. We cannot understand, nor do we desire to understand, the meaning of all the other 'isms' when applied to America."

Greetings

George S. Fanning, president of the American Railway Engineering Association, and chief engineer of the Erie, brought greetings from his association and in his remarks paid particular tribute to the non-technical "artisans" in bridge work, to whom he attributed many of the marked advances in bridge design and construction through the years. He said, in part as follows:

"The American Railway Engineering Association is composed of railway engineers in all fields—track, bridges, buildings, water stations, etc. Your association, on the other hand, is a specialized one, dealing with bridges and buildings, and through it you do something that needs to be done in that you bring the engineer

F. H. Cramer
First Vice-President

H. M. Church
Second Vice-President

R. E. Dove
Third Vice-President

F. H. Soothill
Fourth Vice-President

F. O. Whiteman
Secretary

F. E. Weise
Treasurer

Bridge and Building Association

Officers 1939-40

A. E. Bechtelheimer, president, assistant engineer of bridges, C. & N. W., Chicago.

F. H. Cramer, first vice-president, bridge engineer, C. B. & Q., Chicago.

H. M. Church, second vice-president, general supervisor bridges and buildings, C. & O., Richmond, Va.

R. E. Dove, third vice-president, assistant engineer, C. M. St. P. & P., Chicago.

F. H. Soothill, fourth vice-president, chief estimator, I. C., Chicago.

F. O. Whiteman, secretary, Chicago.

F. E. Weise, treasurer, chief clerk to chief engineer, C. M. St. P. & P., Chicago.

Directors

Armstrong Chinn, past president, chief engineer, Alton, Chicago.

(Term Expires October, 1940)

B. R. Meyers, trainmaster, C. & N. W., Mason City, Ia.

W. Walkden, bridge engineer, C. N. R., Winnipeg, Man.

A. S. Krefting, assistant engineer, M. St. P. & S. S. M., Minneapolis, Minn.

(Term Expires October, 1941)

A. M. Knowles, assistant engineer structures, Erie, Cleveland, Ohio.

L. G. Byrd, supervisor bridges and buildings, M. P., Poplar Bluff, Mo.

K. L. Miner, supervisor bridges and buildings, N. Y. C., Beacon, N.Y.

into close fellowship with the supervisors, master carpenters, master masons and foremen, whom I might call the artisans in bridge and building work. All meet here to discuss their common problems.

"Representing an engineering body, I want to pay particular respect to the men who are not engineers. I want to tell you how much we engineers appreciate the loyal support and co-operation that we get from you supervisors and your foremen, and other practical men in the field. We lean on you, and we lean on you very heavily.

"Your organization has been in existence forty-seven years — longer than ours—which is as might be expected because long before there were engineers, there were artisans in bridge construction. Back in the medieval days, wonderful viaducts and beautiful cathedrals were built, not by engineers and architects, but by master masons—men who were the forerunners of the group of men that you constitute today. Even in later days, some of our most interesting structures, with their many engineering features, were not conceived by engineers and architects, but by masons. And a wonderful job they did. These are some of the things for which engineers are indebted to the artisans, and I am here to thank you on behalf of the engineers for what you have done."

Turning briefly to the broader responsibilities of bridge and building men in these strenuous days, Mr. Fanning said that, beautiful as bridges may be in themselves, "they are worthless except as they carry highways and railways—the arteries of human traffic—which, throughout the years have been the means of communication between different parts of the world and, as such, have really been the foundation upon which civilization has been built." Therefore, he urged members of the association to "expand your thoughts beyond the bridge—first, to the problems of the railways as a whole, and second, to the pressing problems of civilization today."

Greetings from the Roadmasters' and Maintenance of Way Association were brought by its president, J. J. Clutz, division engineer, Pennsylvania, Indianapolis, Ind., who spoke of the close ties that have always existed between the two associations, of their respective obligations, and of the opportunities which they afford for the free discussion of common problems in the interest of their members and the railways which they represent. "These two associations have been closely affiliated throughout their existence — a period of nearly 50 years," he said.

"They have a common objective—to meet and discuss questions pertaining to their respective but closely related fields, and to raise the standards of work committed to the charge of their members.

"The right to assemble freely and to discuss questions of common interest is a precious heritage—a right which now exists in few other countries of the world; but, like the right to vote, this heritage is of little value unless it is exercised. Associations such as ours perform a useful service only as our members take an active part in their activities, and particularly in the exchange of ideas at our conventions. Through a free discussion of your committee reports and other subjects which may arise, ideas are communicated to others, which would otherwise remain locked up in one man's mind; facts based on experience, are shared, and everyone benefits. Thus, the objective of the association is realized, and you go back to your job stimulated in mind, refreshed in ideas, and better able to carry on your work efficiently and economically because of what you have learned."

Members of the Bridge and Building Association Inspected the System Stores Facilities of the Chicago, Burlington & Quincy at Aurora, Ill., on October 17.

President's Address

In his presidential address, President Bechtelheimer reviewed the activities of the association during the year with some satisfaction, but he saw still large opportunities for members to gain from the association's activities, and urged a more intensive drive for new members among bridge and building men to the end that they and their roads might derive the large benefits available through active membership. He also spoke of the pleasant relationship and close co-operation that has existed with the American Railway Engineering Association, the Roadmasters' and Maintenance of Way Association, and railway managements. Of the latter, he said:

"Our relations with railway managements have brought us to a better understanding of their attitude with respect to association work. The executive officers of many roads have disclosed a very keen and kindly interest in the work we are doing and have shown that they recognize that conscientious effort on our part in the study and solution of our problems will be of great benefit and value to us and to the railways. It is my opinion that this friendly spirit of encouragement and co-operation will continue as long as we are able to show by our earnest attention to these matters that we can accomplish things of real value to ourselves and to the railways which we represent. This convention, which is the high point in the year's work of our association, expresses in concrete form our purpose to do that very thing, and by so doing, to bring vital, worth-while information to those interested in the many problems facing bridge and building men.

Mr. Bechtelheimer expressed particular appreciation of the work of the many committee chairmen, vice-chairmen and members who had volunteered for their work, saying in part as follows:

"You have done a splendid job at a sacrifice of many hours from your work and from your relaxation time. Nearly all of the 134 men working on committees volunteered for the work. Have you ever wondered why men do these things? They do them because they are rewarded by the joy of finishing a job when once started; by the satisfaction gained in accomplishment; by the benefits derived

from increased knowledge and experience; and by the satisfaction gained from enlarged acquaintance. They know the value of association work in helping men to be alert in fact-gathering, active in efforts for improvements, and aggressive in meeting new situations."

In closing his address, Mr. Bechtelheimer called for more extensive use of the association's findings in the interest of increased efficiency and economy, and for greater promotion of the association among those who should be numbered among its active members in the interest of the greatest service to these men and to the roads which they represent.

Bruce Dwinell Says Foremen Hold Key to Many Railway Problems

SPEAKING before the annual luncheon on Wednesday, Bruce E. Dwinell, general counsel of the Chicago, Rock Island & Pacific, traced the rapid political, economic and technological developments in the United States since Revolutionary War days; pointed out the problems that these rapid changes have brought about for the railways and for other industries through increased taxes, increased commodity prices and increased wages; and then placed upon railway supervisory officers, and especially upon foremen, the responsibility for better labor relations, increased efficiency and decreased costs, in which alone, he said, lies the salvation of the railways. In the latter regard, he said, in part, as follows:

"Today we are beset on every side by increased costs, increased taxes, increased wage bills and increased commodity prices. I do not say that you can do anything about increased taxes. I do not say that there is anything that you can do about the diversion of traffic incident to the motor truck on the highways, but in your hands, and in the hands of men who are occupying positions like yours, lies the answer to at least the problems of increased costs, no matter what they may be. The salvation of the American railroads lies in just one thing —increased efficiency at decreased cost. If the American railroads cannot solve this problem satisfactorily, it cannot be said that our future is very long.

"The problems that have confronted the railways are also confronting our competitors. They, likewise, are confronted with the problem of higher taxes. Eventually, their tax bill will equal ours. They are confronted with the problem of increased wage costs, which has been one of the unfair things that we have been compelled to face in the last few years. Just as scientific advancement has injured us, we may expect that scientific advancement in the future may injure them also, so that a part of our burden will be taken away from us by the equalization of competitive conditions.

"But even if this comes about, there still remains for us to face the questions of how we are to decrease our costs and are to cope with our labor problems. One thing is certain, and that is, if we are to survive, we must deal more and more intelligently with the labor problem. One of the difficulties which you men have in your handling of labor is the fact that the territories over which you have jurisdiction are vast in extent. Our railroads cover large territories and they employ men who are scattered over each entire system. This makes the problem of supervision extremely difficult.

"You men who are in charge cannot give to the individual labor problem as it arises the individual attention which it well deserves. You must delegate your authority, and in the delegation of that authority lies much of our hope for the future. The man who has contact with labor is the man who actually works with labor—your foreman. Your employees know your railroad by knowing your foreman. If he is a good foreman, your railroad to them is a good railroad; if he is a bad foreman, your railroad is a bad railroad, at least in so far as that man is concerned.

"It is necessary, therefore, that this foreman be a certain kind of man. A really excellent foreman has to have two qualities. One is technical knowledge of his subject, and the other is the ability to handle men. Of the two, the first is of the least importance initially. Given a certain aptitude, a certain ability, and a willingness to work, men can become technically proficient, but the ability to handle men is something that is born in a man. He either has it or he hasn't it. It cannot be cultivated. It requires honesty of purpose; it requires a knowledge of human nature; and it requires an intense desire to be fair and square. But a man can have all of these qualities and still not be a perfect boss. It takes something of a spark to make him right. So I say that the first thing for you men to do in the handling of your labor problems is to see that you have the right foreman, and that he can handle his men. If he can do that, many of the causes of complaint, which often ripen into real controversies, can be avoided.

Foremen Can Do Much to Improve Labor Relations and to Solve the Problem of Securing Increased Efficiency

"Great advances have been made in the scientific maintenance of bridges, buildings and track since 1916, when, for the first time, the wage rate on the railways began to rise, and it has only been by intensive mechanization that the railroads have been able to keep up with the subsequent rising wage rate, which has been accompanied by rising costs of materials. It is unnecessary for me to go into all of the details of the new machines that have been adopted, and of all of the methods which have been perfected, but I do want to say that only through the utilization of every sort of knowledge, of every sort of device, and of every sort of improvement in operation by you men and others occupying positions of like character, can our operating costs be

reduced and the railroads maintain their place in the sun.

"Yours is a double task. Your first task is to so carry out your work that it results in efficient and economical maintenance of your properties; and your second task is to so handle your personnel that you will secure from them the best that they can give. If you can fulfill this double task, and if others in like capacity in the railroad industry will intelligently follow the same course, there is hope for the railroads in the future. Out of the uncertainty that has been produced by economic, social and engineering changes, will result the certainty which we must have for the future."

Protecting Steel Structures from Severe Corrosion

Report of Committee

LET us determine first what the term "corrosion" means as applied to steel structures. The word "corrosion" is derived from the Latin word, Corrodere, meaning to gnaw. Webster defines corrode as: "To eat away by degrees; to wear away or diminish or destroy small particles of, as by the action of a strong acid or caustic alkali; to consume; to wear away; to impair." From this definition, we may infer that for steel to corrode, it must be attacked and wasted away.

We know from experience that corrosion, unless checked, will rapidly impair steel members of structures to such an extent that partial repairs, or complete replacement, of members, and even of whole structures, becomes necessary. In order that we may understand better what types of materials may be applied to retard or prevent this destruction, it seems advisable to consider the fundamental factors causing corrosion.

A. M. Knowles
Chairman

Ionization of Metals

Pure water is composed of hydrogen and oxygen. The forces that bond these two elements together to form this chemical compound are electrical. Hydrogen (positively charged) unites with oxygen (negatively charged), the two being held together by the mutual attraction of their electrical forces, forming a neutral compound.

The smallest unit of an element which can enter into a chemical change is called an *atom*. In the normal state, an atom is electrically neutral although surrounded by an electrical field composed of an equal amount of both positive and negative charges.

When in combination with other elements to form stable compounds, all elements are in the atomic, or neutral, state. However, an element entering into a chemical union, or leaving such a union, must be electrically charged, either positively or negatively. An element becomes positively charged by losing some of its negative forces; or negatively charged by absorbing negative forces from another element. In this state of electrical unbalance, the particle is called an *ion*.

Metals always become ionic when going into solution in water, water providing the medium by which the electrical forces are transferred. This fact explains why corrosion of metals cannot take place unless water is present. Metals in the ionic condition are always positively charged.

All metallic elements are soluble in water but vary in their rate of solubility. The solution pressure, or comparative speed of solubility, has been accurately measured. The more common metals are listed below in the order of their solvency, or their tendency to go in to solution. For example, potassium goes into water solution so rapidly that it creates both an explosive and a fire hazard.

1. Potassium
2. Sodium
3. Magnesium
4. Aluminum
5. Zinc
6. Iron
7. Nickel
8. Tin
9. Lead
10. Hydrogen
11. Copper
12. Mercury
13. Silver
14. Platinum
15. Gold

Hydrogen is included in the above list in the direct comparative order of its solubility because, although not a metal, is reacts chemically in a similar manner. As we shall see later, hydrogen causes corrosion of any metals having a greater solubility than itself.

When hydrogen ions dissolved in water come into contact with metal of greater solubility, the metal is thrown into solution; that is, the positively-charged hydrogen ions pull negative charges away from the metal atoms, which previously had been surrounded by a balanced or neutral electrical field. Having lost negative charges, the metal atoms become positively charged, are in the ionic state, and are thrown out into solution.

Hydrogen ions are essential to, and initiate, all types of steel corrosion.

Rust, ferric oxide, is caused by relatively small amounts of hydrogen ions contained in atmospheres reasonably free from smoke. The presence of oxygen is necessary to complete the final precipitation of rust. The accumulation of true rust is a comparatively slow process.

Complete rust removal is desirable before painting steel with a drying type film. If it becomes necessary to paint over common rust, good paints will probably give reasonable results because, under warm dry air conditions, little moisture or acid hydrogen ions will be trapped under the film.

Sulphuric Acid Corrosion

When coal burns, the sulphur content unites with oxygen to form a gas called sulphur dioxide. This gas unites with water that is present in steam or in the atmosphere, and forms sulphurous acid. Sulphurous acid unites with additional oxygen to form sulphuric acid. Sulphur leaching from coal also forms this acid.

Pure concentrated sulphuric acid contains no water and boils at 540 deg. F. as compared to water at 212 deg. F. Under hot, dry atmospheric conditions, dilute sulphuric acid will lose water and become more concentrated. On the contrary, pure concentrated sulphuric acid has a great affinity for water, and will absorb and retain it in large quantities. Consequently, under railroad conditions, some acid is always present and is generally in a diluted condition.

The mixture of pure sulphuric acid

and water dissociates the acid. The hydrogen separates from the other elements and goes into water solution. Dilute sulphuric acid is therefore highly corrosive to steel because the positive hydrogen ions in contact with the atoms of iron in steel force the iron out into solution. The steel is continuously and rapidly eaten away because the acid contains an unlimited supply of hydrogen ions.

On exposed structural areas which can be washed by rainfall, some of the acid may be carried away. On unexposed sections this is of course impossible, and liberal amounts of dilute sulphuric acid may always be found on such areas which are subjected to excessive smoke conditions.

Salt Corrosion

Sodium chloride or ordinary salt rapidly dissociates in water. The solution is highly ionized because of the great solubility of sodium and chlorine. The sodium carries the positive charge; the chlorine the negative charge. The water in the brine solution also dissociates into *hydrogen ion* and hydroxyl ion. The dissociation is so complete that billions of ions are concentrated in a cupful of brine.

As atoms go into solution, a back pressure develops which tends to prevent additional atoms from coming into solution. Maximum resistance is obtained when the solution becomes "saturated." If by some means part of the ions are removed from the solution, additional atoms will come into solution. The presence of chlorine ions accelerates the rate of corrosion of steel because the chlorine ions rapidly unite with the iron thrown into solution by the hydrogen ions. Due to this ready union, the resistance pressure is kept at a minimum, and additional iron ions come freely into solution.

Another reason why salt accelerates corrosion of metals is that brine is an excellent electrical conductor because of the high degree of its ionization. An additional factor is that chlorine is a tremendously active element. That is, although it has a greater natural affinity for the sodium ion, the chlorine ion will readily unite with the iron ion.

Causes of Severe Corrosion and Parts of Structures Affected

Reports from previous committees and from members of this committee, as well as statements recently received from many railroads, indicate that the major causes of severe corrosion, in the order of their importance as destructive influences on railway structures, are as follows:

(1) Brine and urine drippings from cars.

(2) Gas, smoke and cinders emitted from locomotives.

(3) Coal, cinders, debris and dirty ballast, accompanied by moisture.

(4) Salt water or fogs, and salt water spray.

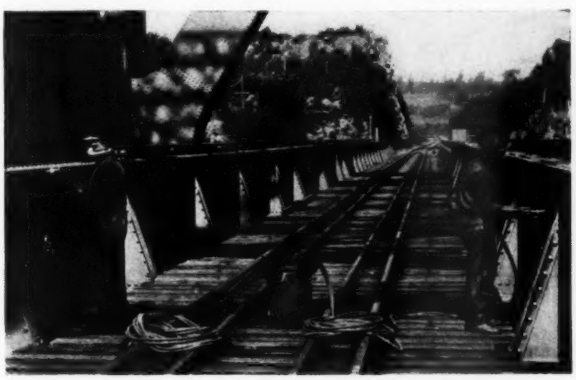
(5) Dampness in unventilated places where sunlight is excluded.

(6) Ordinary water.

(7) Ordinary atmosphere.

It is quite generally accepted that railroads carrying heavy refrigerator car traffic find brine to be the outstanding cause of corrosion. The main line of nearly every railroad and, to a lesser degree, some branch lines are affected. Urine has about the same effect as brine because it contains salt as well as acid, but only a comparatively few railroads hauling heavy stock traffic are severely affected by urine. Steel work in large shop, freight and similar structures is sometimes severely corroded by the urine of employees.

Brine is doused on bridge steel over the area between and extending about three feet outside the rails. Corrosion is intensified on bridges in and adjacent to yards and terminals, and on bridges located on curved track because the jostling of cars when starting, and their tilting on curves releases a greater volume of brine. Ballasted floor bridges are less affected by brine than open floor bridges.



Protecting Their Steel Structures Against Corrosion Is One of the Large Problems of the Bridge and Building Forces

Acid-forming gases, smoke and blasts from locomotives, affecting bridges or structures over the tracks, are the second greatest source of corrosion. The less the clearance over the tracks, the greater is the damage. Their effects are augmented by pockets in the underside of such structures which prevent the gas and smoke from escaping. Such corrosion is intensified when locomotives stand or pass frequently under structures in yards or terminals. When such overhead structures carry railroad tracks, and are also subjected to brine from above, a doubly severe corrosion problem is created.

Other miscellaneous structures affected by severe corrosion are smoke stacks and ducts at power houses, water tanks, train sheds, steel sash, signal bridges, turntables, steel coal pockets, track coal and ash hopper beams, track scales, and various other terminals facilities where steel members are subjected to gases, cinders, dust, dirt and moisture.

The effect of corrosion on all of these structures is ultimately the same, namely reduction in section. The outstanding legs of angles in the top flanges of stringers and girders are weakened by loss of section and often develop longitudinal cracks along the fillets of the angles; occasionally half moon shaped sections break out, probably because of reduction of section and consequent overstress. The lateral angles in deck bridges sometimes become so thin from corrosion that they snap off under vibration. Many other conditions could be cited to show the far reaching effects of corrosion.

Eliminating the Causes of Corrosion

If the causes of corrosion could be eliminated at a reasonable cost, our problem would be solved. Various methods have been practiced and suggested. Brine results from the use of salt and water ice in refrigerator service. Some cars are equipped with brine retaining tanks which are supposed to be drained at designated places. Unfortunately, this equipment becomes defective and, until repaired, permits the brine to drip while in transit. Many refrigerator cars are equipped with ice bunkers from which the water is free to drip at will. Salt, while not always used in these ice bunkers, is necessarily used in thousands of cars and constitutes the greatest menace to steel bridges.

Consideration has been given at various times to the possibility of equipping these bunker cars with

brine tanks, but the American Association of Railroads has found that this is uneconomical for the following reasons:

(1) Only a small percentage of the refrigerator cars in daily operation are treated with ice and salt.

(2) The added weight of the containers, as well as their cost, is quite objectionable from an operating point of view.

The Association of American Railroads is making tests on the introduction of a solution of sodium dichromate into the brine as an inhibitor, which, if it proves effective, will alleviate this trouble. Mechanical and dry ice refrigeration have heretofore been considered too expensive, but an article in the August 3, 1940 issue of the Railway Age shows great possibilities in the use of dry ice in coordination with water ice without the use of salt. It is claimed in this article that this system can be used in refrigerator cars without change, is more efficient, and costs no more.

As long as coal burning locomotives are in service, there is little possibility of eliminating smoke gases and cinder blast, which constitute the second greatest source of corrosion. With electric and diesel engines coming into more general use, it is to be expected problems will diminish proportionately.

Frequent removal of cinders and of dirt laden with moisture will eliminate many acid corrosion problems.

A few roads have resorted to the use of several devices to reduce the damaging effects of brine on open floor bridges. Among these are the following: Metal troughs or timber spacing blocks between the ties are sloped to throw the brine off the steel work within the limits of the decks. Creosoted timber raising pieces are placed longitudinally on stringers or deck girders and under the ties and extend over the edges of the flanges. Wrought iron and alloy steel plates, and fabrics saturated and mopped with various coatings are also employed in this manner. Formed galvanized sheets are used over cross frames and laterals. Many other methods are in use.

To protect structures over tracks, "blast plates" are suspended from or attached to the structures. Some of these consist of alloy steel, wrought iron, cast iron, ingot iron with a bituminous mat on both sides, or creosoted timber and concrete slabs. Special coatings of paint with grit embedded and Shotcrete encasing steelwork are also used.

When corrosion has destroyed parts of bridges beyond a safe limit, many novel methods of repairs and renewals are employed. Some roads employ alloy steels. Others use excess material to allow for future reductions. The many phases of this work and details of repair are very interesting, but space here does not permit lengthy discussion.

Application of Protective Coatings

At least three railroads have metallized some steel structures. In all cases the steel to be coated was first cleaned by sand blast. The coating was then applied by a gun, operation of which requires compressed air, oxygen, acetylene and metal wire, the wire being fed into the gun, melted, atomized and sprayed, all in one process. Zinc, aluminum, tin, lead and cadmium are the metals commonly used for corrosion resistance.

Several railroad bridges have been so treated with a zinc coating, one as early as 1934. One road reports the total cost as ranging from 50 cents to 65 cents per square foot. Another gives the cost of treating a 50-ft. deck girder span before it was installed as \$114.75 for material and \$350.31 for labor. A boiler stack was given a lead coating on the inside and aluminum on the outside. A switch tower was also treated with a zinc coating. It is reported that these coatings have been quite successful to date, but too expensive for general use unless their service life proves to be proportionately longer than that of the paint.

A few roads have installed electric devices in steel water tanks to avert corrosion of the inside surfaces in contact with water. Your committee has no reports on the success of this device. The A.R.E.A. Committee on Water Service, Fire Protection and Sanitation will present a special report on this subject at the next convention, which should be of interest to maintenance men.

A report presented last year stated that "To stay or remedy the effects of deferred general painting, maintenance men have resorted to spot painting, touching up those parts of their bridges that are exposed to either brine or to locomotive gas action, when required. In doing this spotting, many roads are using special coatings such as bridge cement, crude oil, asphalt oil, black oil with an asphalt content, slushing oils, asphalt paints, tar paints, asphalt roofing compounds, grease-like rust preventatives and rust removers, rust inhibitors, and rust emulsions."

A recent re-check with a large number of railroads, well distributed throughout Canada and the United States, substantially corroborates the above quotation. These products are largely non-drying types of materials. Considering that drying type films have been used on steel structures for so many years, there must be a good reason why maintenance men are resorting to such a variety of coatings of another character.

A perusal of previous committee reports of this association and recent statements from many maintenance officers of railroads reveals that results reported for any one protective coating are not always the same. Differences of opinion also exist as to the relative merits of the many different kinds and types of protective coatings. The question arises why this should be so, and also how we may take best advantage of the materials available.

Many men charged with the selection of protective coatings have more or less knowledge of the fundamental factors causing the several types of corrosion, and understand the fundamental chemical and physical properties of paint films. However, there are a considerable number of these men in general charge of painting programs, and still more of the field men who actually direct the work on the job, to whom these features are still somewhat of a mystery.

The latter may, for this reason, take less interest in the problem than they would if they had a better understanding of the fundamental factors. Yet the success of any material used may depend largely upon the care and understanding with which it is applied and "lived with" on the job.

The paint chemist formulates a variety of paints to combat the various agencies destructive to steel. Many types of pigments, oils and resins are employed in an effort to meet the requirements of a given condition. Maintenance men, confused by this situation, have relied too much on the claims of manufacturers, without giving consideration to many of the practical and technical aspects of the properties of protective coatings.

Properties of Protective Coatings

Previous reports mention the use of drying and also non-drying types of protective coatings. A drying type film is one which eventually reaches a condition of brittle hardness at the expiration of its effective life, while a non-drying film retains its oily-wetness as long as it exists, that is, until it is weathered away. Careful investigation discloses that each is particularly fitted for a specific purpose.

Drying Films

We learn from the United States Government Forest Products Laboratory, that drying-type paint films are never entirely waterproof, their efficiencies ranging from 18 per cent for

three coats of linseed oil to a maximum of 98 per cent for three coats of the best paints. Chemically-laden moisture will pass through these films in proportion to their degree of waterproofness.

Chemically active pigments are used in steel primers in an attempt to inhibit the chemicals which pass through the films and nullify their attack upon the steel. In order best to utilize their inhibitive qualities, it is necessary that we use a highly waterproof film which will remain so for a long period of time. Many paint films of high initial moistureproofness lack the ability to retain their waterproofness after a short period of exposure.

The passing of an excessive amount of moisture through a pigmented film is detrimental for several reasons. If the pigment is highly soluble, it will be dissolved wastefully and although its degree of protection will be excellent for a short time, it quickly loses its effectiveness because the supply of pigment is soon depleted. If the pigment is only slightly soluble, insufficient amounts will go into solution to offset the corrosive action of the moisture passing through.

Chromated pigments, such as zinc chromate, possess powerful inhibiting properties. In water solutions they form a thin transparent non-magnetic oxide film on steel which is impervious to acids or salts of any concentration. This barrier is mill scale such as found on hot rolled steel. The thickness of the chromate formulated film is microscopic. It is subjected to the same expansion stresses as ordinary scale but the fractures are readily resealed as additional chromate goes into solution.

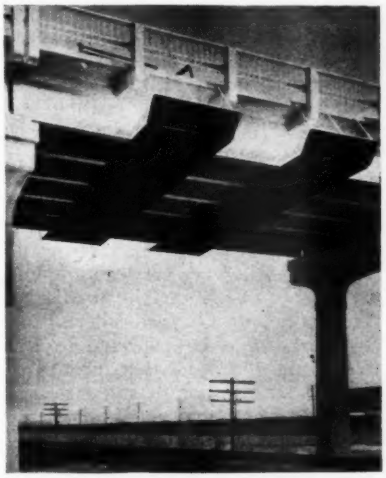
Acids are neutralized by alkalies. The positive acid hydrogen ion (H^+) combines with the negative alkaline hydroxyl ion (OH^-)to form neutral water (H_2O). In the form of lead or zinc oxide, either unites with water which passes through the film to form the alkaline radical (OH^-).

Drying type films, which are highly effective when applied over properly cleaned steel, lose much of their efficiency when applied over salt or acid corrosion left beneath them. The inhibitive properties of the pigments are generally taxed to capacity in inhibiting any chemically-laden moisture passing through the film, and therefore cannot exert sufficient influence to overcome the effect of chemicals under them. Chemicals beneath the film eat away the steel rapidly and undermine the film above. Obviously, best service from drying type films will be obtained when they are applied over well-cleaned steel.

Generally, drying films applied over clean steel do not fail primarily because of moisture passing through the film, but more often because the chemicals gain access at cracks and fissures and eat away the steel more or less rapidly, undermining the film.

Non-Drying Films

Uncleaned, chemically corroded surfaces seem to be most effectively protected by non-drying films. Due to their oily-wetness, they penetrate the



Plates of Suitable Materials Are Used Effectively to Protect Overhead Structures from Locomotive Blasts

rust completely. The particles of chemically-laden rust are surrounded and isolated. In a manner, the position of the rust is relatively an exterior one, that is, it is not in contact with the steel and does not lie beneath the protective coating.

Primarily, the actions of the non-drying coatings are physical. They are free throughout their life to advance into cracks and crevices, and to seep into rust. Moisture will retreat from an oily-wet film so that undermining is reduced to a minimum. The films are self-healing and highly moistureproof. They do not soften or hydrolize under continual water submersion, as do the drying films.

The non-drying coatings are effective rust removers and exert their protective influence without the necessity for costly cleaning. They are comparatively inexpensive and are economically applied in a single heavy coat. They give good protection under conditions which are ruinous to drying films, regardless of their qualities or their thickness.

Moisture pockets created by structural design present a great problem in conjunction with the drying type films. When the non-drying films are used, these pockets serve as reservoirs for liberal amounts of the coating and continuous oil-wetting of the steel is assured. Even though the non-drying coatings need be applied at more frequent intervals, their great economies appear to justify their use under the more severe corrosive conditions resulting from acids and salt brine.

A maintenance officer of one of the large railroads, who has used one of these materials, states that "we do not know how we could have preserved our bridge steel to anything like the degree we have done since 1932 without having gone to the use of these products. By their use we have extended protection to a fair degree to as much as 5 to 10 times as much steel as we could have protected by the old method of painting."

Conclusion

The protection of steel railroad structures against severe corrosion is one of the maintenance problems which requires constant, painstaking attention. This includes the selection, the application and the care of protective coverings. No matter how suitably formulated the materials may be for a specific type of corrosion, their effectiveness depends largely on their application in a proper manner, to suitably-prepared surfaces, at the right time.

Reports from many railroads indicate that the degree of attention varies over the country. Where corrosion is not excessive, or is not allowed to become acute before it is given attention, no serious harm results. Where neglect or inattention has permitted serious inroads on vital parts, expensive structural repairs or renewals are often necessary.

Some railroads continue to use dry film paints on parts of steelwork attacked by brine and gas with reasonable success, while others have poor success with such coatings. The use of non-drying coatings is apparently gaining favor at present for parts affected by brine. Only time will tell how satisfactory any of these materials will prove to be. There is evidence that a real effort is being made by maintenance officers and their subordinates to find the best possible solution of this problem.

Committee—A. M. Knowles (chairman), asst. engr. structures, Erie, Cleveland, Ohio; R. W. Johnson (vice-chairman), asst. engr., C. M. St. P. & P., Chicago; C. A. Bouton, asst. gen'l. for., N. Y. C., Ravena, N. Y.; H. M. Buell, bridge insp., U. P., Omaha, Neb.; Armstrong Chinn, ch. engr., Alton, Chicago; H. H. Eggleston, for. b. & b., C. G. W., Des Moines, Iowa; J. M. Erickson, supvr. b. & b., Ann Arbor, Owosso, Mich.; L. D. Garis, bridge insp., C. & N. W., Chicago; H. W. Hauerslev, ch. dftsman, C. M. St. P. & P., Chicago; J. W. Kidd, supvr. b. & b., Sou., Atlanta, Ga.;

E. M. McCabe, supvr. b. & b., B. & A., Pittsfield, Mass.; F. M. Misch, insp., S. P., Redding, Cal.; J. M. Salmon, Jr., asst. supvr. b. & b., L. & N., Louisville, Ky.; C. U. Smith, G. M. & C E., Har. Com., Milwaukee, Wis.; H. C. Stevens, gen. for. b. & b., N. Y. N. H. & H., Boston, Mass.; M. G. Tribe, mast. carp., Erie, Salamanca, N. Y.; J. L. Vogel, br. eng., D. L. & W., Hoboken, N. J.; W. W. Walkden, br. eng., C. N., Winnipeg, Man.; W. E. White, gen. for. b. & b., A. T. & S. F., Chanute, Kan.; H. A. Wistrich, br. eng., L. V., Bethlehem, Pa.

Discussion

E. C. Neville (C. N. R.) described the experience of his road in the use of oil as a protective coating for steel bridges. Several years ago, at a time when bridge painting had been deferred for a number of years, he said, his company inaugurated a practice of spraying oil on the corroded parts of bridges and has obtained satisfactory results. Where necessary, the oil is applied each year, but, in most cases, he said, after the first year it is necessary to apply it only to the more exposed parts. The yearly cost of treating steel structures in this manner, he said, is about six cents per lineal foot of single-track bridge. Mr. Neville stated that a chemically-treated grease is also being employed with satisfactory results, and that the flame-cleaning and descaling process is being used successfully for cleaning bridges preparatory to painting them.

G. W. Rear (S. P.), in discussing the bridge painting practices of his company, described the effect on the paint in the case of a steel span that had fallen into the ocean and had been submerged for about a year. This structure had been painted with two coats of red lead and one coat of carbon black. When the steel was removed from the water, it was found that, while the surfaces were covered with marine growth, the red lead was substantially intact. It was Mr. Rear's opinion that protective coatings of lead and oil paints leave the surfaces in better condition for repainting at a subsequent date. He explained that it is the practice on his road to use such paints in cases where they will last five years or more. He saw no particular difference between graphite and carbon black for the final coat. At locations on his road where paint coatings cannot be expected to last five years, he said that protective coatings of the non-drying type are applied, except that the bridges are painted with lead and oil paint when erected.

Answering a question regarding the protection of steel piles exposed to erosion, Mr. Rear said that this can be accomplished by encasing the piles in either concrete or a bituminous material. In this connection, Chairman Knowles cited the experience of the culvert manufacturers in their search for a suitable culvert paving material. Their finding was, he pointed out, that soft materials give better results than harder substances.

The discussion continued with a warning against the use of cheap oils containing acids and sulphur compounds with the idea that they will protect metal surfaces from corrosion. On the contrary, it was brought out, they are likely to induce or accelerate the corrosion that they are trying to eliminate. Considerable time was given to the difficulty of inspecting bridges to which the grease inhibitors have been applied. Several members cited examples of their inability to make proper inspection because of the danger of slipping while out on the members.

Mr. Rear stated that on his road it is customary where corrosion is particularly severe on cover plates or under bridge ties, to soak canvass in red lead paint, allow it to dry for one or two days, and then apply it over the stringers as a protective covering.

The Adjustment of Locomotive Watering Facilities to Larger Tenders and High-Speed Trains

Report of Committee

DURING the last 10 or 15 years, the railroads have been forced to provide faster and more dependable freight and passenger service to meet the competition of other forms of transportation. The effects of this have been felt in every department. One of the developments that has been necessary as the result of this speeding up of schedules, which has involved larger power, larger tenders and longer engine runs, has been the re-adjustment of locomotive watering facilities. This development has presented a variety of problems with which we must deal.


W. G. Powrie
Chairman

In general, the larger tenders and extended engine runs have required improvements or additions to facilities at some water stations to meet increased demand, and have left other wayside stations non-operative. The retirement of these latter stations should be undertaken only after giving them most careful study, because, in times of increased business or in cases of emergency, such as bad weather conditions or failure of the equipment at the regular water stations, these seemingly unimportant stations may become very important to the movement of trains.

In our discussion of the various problems covered in this report, no attempt will be made to establish definite rules or practices to be followed as there are but few instances where duplicate conditions can be found.

Storage Capacity

The advent of larger locomotive tenders and through engine runs have changed considerably the demands on locomotive water stations. This change in demands can be met either by changing the amount of storage capacity or by changing the rate of refilling storage tanks, or both. Many terminal storage tanks, which were considered adequate a few years ago, have been found entirely too small for the requirements now placed upon them. This has been brought about by the fact that the larger locomotive tenders now in use have eliminated the necessity for taking water at many wayside stations and have thus thrown an increased load on the terminal facilities. In many instances, wayside

stations have been found no longer necessary. Several roads have reported that from 20 to 25 per cent of their water stations have been retired within the last 20 years. At one time a mid-western road had 26 steel tanks, all in condition for use, but of little or no value in their present locations. Most of them have since been cut down and disposed of or re-erected elsewhere.

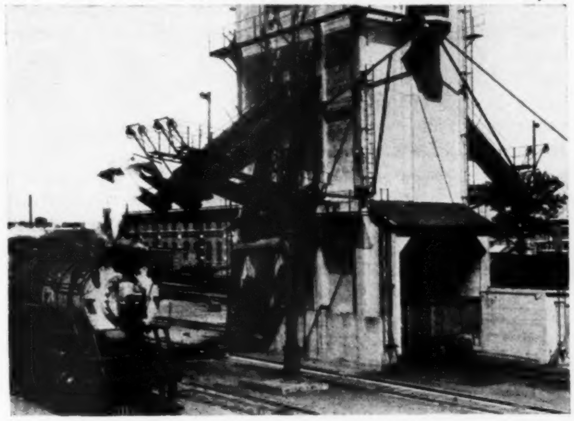
Study Shortages

The problem of increasing the available supply of water for locomotives at a water station is not always a matter of increasing the storage capacity. A careful study may develop that the storage facilities are ample but that the pumping equipment is too small or that some other factor is effecting a slow rate of delivery to the tank. One road reports that at one of its stations, which had a 50,000-gal. wood tank fed by gravity from a reservoir two miles away through one mile of 8-in. pipe and one mile of 6-in. pipe, they could not fill the requirements for water. There was an ample supply of water in the reservoir, but the tank and pipe line were too small to take care of the demand. A new 100,000-gal. tank was erected and the 6-in. supply line was replaced with 8-in. pipe. This still did not give them enough water during periods of increased business, although the total head on the tank was theoretically sufficient to overcome the friction in the supply pipe and to keep the tank full.

As a result of this situation, all features of the installation were checked and rechecked and it was finally decided to remove the float valve in the top of the tank and let the water flow continually. This was done because it was noticed that the flow to the tank was considerably less when the valve first opened than it was after the water had been running for a time. From that time on the road experienced no more water shortage trouble at this station. It was concluded that the continuous flow of water through the pipe line prevented the formation of air pockets which had been forming previously and had been cutting down the free flow from the reservoir to the tank. This experience is cited to show that oftentimes the facilities are adequate to meet the demand if they are in proper working order.

In other cases, however, it has been necessary to increase the storage capacity, especially where the natural water supply is limited. In these cases, pumps of low capacity must be used and must sometimes be operated 24 hours daily, pumping to large storage tanks in order to meet the demand.

Not only the total demand for water, but also the distribution of this demand is important in determining the proper size of facilities required at a water station. Where the demand is spread out evenly over the 24-hour period, the storage capacity and pumping equipment need not be as large and as costly as where the demand is concentrated within a few hours.



This Point on the Burlington at Creston, Ia., Provides for Coaling, Sanding, Pan Cleaning and Watering at the Same Time

Expedited Delivery

The speeding up of both passenger and freight train schedules, with the subsequent shortening of stops, has emphasized the problem of proper design. The first changes that were necessitated by the larger tenders were the raising of the tank spouts and water columns. In the case of the tank spouts, this was often done by inserting a beveled wood washer in front of the outlet elbow, which flattened the slope of the outlet pipe and raised the spout end the required amount. In some cases, where this would not accomplish the desired raise and where the tank was in good condition, the entire tank and tower were raised.

The spouts of water columns were raised and otherwise adapted by inserting flanged spools in the upright columns and lengthening the operating rods by welding on extensions in the field. In many cases, the raising of water facilities to accommodate tenders 12 to 13 ft. high presented a problem when watering tenders with a manhole height of about 9 ft. This has been more pronounced with the rigid type of water columns than with tank spouts or water columns with telescopic spouts. This difficulty has been partly overcome by installing a hinged extension to the nose of the rigid spout, to be used when watering low tenders, and to be swung back when watering high tenders.

The next problem was to cut down the time required to take water. Delays due to extra stops for water can sometimes be eliminated by relocating present facilities, or by providing additional facilities so that coal and water can be taken at the same time or, in the case of passenger trains, so that water can be taken while the train is at the regular station stop. The rates of flow from water columns can be increased in several ways.

(1) Increase the size of the pipe line serving the water column.

(2) Increase the size of the water column.

(3) Increase the flow head where the water column is served from a storage tank.

(4) Locate the storage tank as close as possible to the water column.

No fixed rule can be set for all cases as there are too many variable conditions between problems. Each case must have a separate study to produce the best results in the most economical manner.

Consider Operating Costs

Although the matter of original cost is very important, maintenance and operating costs should be given proper consideration. For example, an increased water column flow might be obtained by increasing the height of the storage tank instead of spending a small additional amount to increase the size of the pipe line from the tank to the water column. However, the pumping costs due to the higher tank head may be increased to such an extent that the extra cost of the larger pipe line may be justified.

In connection with the location of water facilities to accommodate high-speed, through freight trains, it might be well to point out that the question of blocking street and highway crossings has become acute at many locations. To avoid this, water stations have sometimes been developed be-

tween towns where freight trains, often a mile long, can take water without blocking important crossings.

First Cost vs. Maintenance

The developing and enlarging of the equipment at main water stations has presented a cost problem that has been very important, especially during times of depressed business. The necessity for greater storage capacity and for faster deliveries to water columns has required larger and higher tanks and larger pipe lines, fittings, etc. This, in turn, has resulted in a wider use of all-steel elevated tanks of improved design since, in the larger sizes, it is more practicable to construct with steel than with suitable tank woods.

The retirement of water stations due to increased locomotive tender capacities has made many tanks available for re-erection elsewhere. It has been found practical and economical to cut down steel tanks by burning the sheets out in sections and welding them back together at the new locations. Wood tanks can also be moved successfully if proper care is used during the dismantling work to avoid damage to the materials. In cases where it is necessary to erect new storage tanks, careful consideration should be given to the types of materials to be used and to proper design so as to insure the lowest possible future maintenance costs.

Pumping Equipment

The replacement of obsolete pumping equipment with new modern equipment has often reduced maintenance and operating costs considerably. The newer types of equipment are much more efficient and lend themselves more readily for use with automatic controls, which, in turn, reduce operating costs. The savings effected by replacing cumbersome and worn out piston pumps or deep well pump jacks with modern electrically-driven centrifugal or turbine pumps have often paid for the installation costs within two or three years. Of course, the use of electricity is governed by the availability and cost of electric power, and it is not always possible or economical to convert to this type of equipment. In many cases, especially where the winters are severe, it has been deemed advisable to retain steam pumping plants so that the steam will be available for preventing the freezing of tanks, valves, pipe lines, etc. The maintenance and operating costs of these steam plants may be higher than similar costs for electrically-operated equipment, but a supply of water is insured during the winter months.

The importance of dependable water supplies has been greatly increased because of the general reduction in the number of water stations. This has emphasized the necessity for careful planning and use of quality materials and equipment to avoid costly maintenance and delays due to breakdowns.

Frost Protection and Drainage

The problem of frost protection is one of extreme importance to roads operating in northern climates where freezing weather is encountered for five to seven months of the year. The water consumption during these months is usually greater than it is during the rest of the year and the maintenance of an adequate supply is imperative. Ordinarily, underground pipe lines give little trouble because of freezing since they are laid, wherever possible, below the frost line. However, care must be taken to prevent freezing in pump pits, meter and valve pits, water column pits and riser pipes to storage tanks. The best common insulation against heat transfer is dead air space and all commercial insulating materials depend more or less on this property. Certain kinds of wood, cork, rock wool, etc., because of their porous nature, contain an infinite number of dead air spaces and are therefore good insulators. Hollow tile and blocks of porous material of a concrete nature are also used because of their appearance and durability.

The frost-proofing of pits is usually accomplished by providing additional insulation across the top of the pit, although the walls are sometimes also lined. The amount of protection required depends, of course, on the climatic conditions. It is often necessary to provide heat by means of steam pipes, or electric, oil or charcoal heaters. The riser pipes to storage tanks are usually protected by a box, constructed primarily of alternate layers of wood and dead air spaces. Masonry frost boxes are also being used on many wood tank installations. The initial cost of a masonry frost box is somewhat higher than that of a wood frost box, but the maintenance costs are less. One bad feature of the wood frost box is that the moisture inside the box accelerates deterioration of the wood and reduces its insulating properties, increasing the possibility of freezing of the riser pipes.

Very often trouble is experienced by the freezing of the water in storage tanks, thus making the tank outlet valve or the operating rods and the indicator and automatic control floats inoperative. This is true especially where the water requirements are erratic and where the water is pumped from a stream or lake where it is already near the freezing temperature. This situation can be remedied partly by placing the valve operating rod and floats in oil tubes, or by housing in the tank tower and providing heat. It is good practice for maintenance men to canvass their territories yearly with the view of anticipating and preventing future freezing troubles.

Water Hammer

With the necessity for faster rates of flow from water columns, the problem of dealing with water hammer has become more and more important. Water columns are equipped with slow-closing valves which gradually choke off the supply and reduce the rate of flow in the pipe line to the point where the water hammer developed by the final closure of the valve can usually be handled by a relief valve. Ordinarily, water hammer does not present much of a problem when the water column is supplied by the railroad's own storage tank, as the pressure head is rarely more than 60 ft. or 26 lb. per sq. in. However, when a water column which delivers 5,000 gal. per min. is connected directly to a city main under a pressure of 75 to 85 lb. per sq. in., water hammer becomes a serious problem. In several such cases it has been necessary to install two or more relief valves in the supply line to take care of the surge. The subject of water hammer is very involved and it is practically impossible to predict the effects of water hammer upon city mains. In most cases it can be controlled by the use of proper relief valves, although this is not always true. In several cases involving city mains where increased flow rates were required, it became necessary to disconnect the water column from the city main and to install storage tanks because it was apparently impossible to stop the disturbance in the mains due to water hammer.

Committee—W. G. Powrie (chairman), engr. w. s., C.M.St.P.& P., Chicago; A. S. Krefting (vice-chairman), asst. engr., M. St.P.& S.S.M., Minneapolis, Minn.; R. T. Burns, supvr. w. s., C.& N.W., Boone, Ia.; L. A. Cowsert, water insp., B.& O., Dayton, Ohio; C. E. Crippen, asst. engr., C.M. St.P.& P., Chicago; E. G. Day, ch. engr., L.S.& I., Marquette, Mich.; E. E. Fobes, asst. supvr. b. & b., N.Y.C., Albany, N.Y.; C. G. Freits, asst. supvr. b. & b., C.& N.W., Winona, Minn.; A. W. Harlow, mast. carp., Erie, Huntington, Ind.; C. R. Knowles, supt. w. s., I.C., Chicago; A. F. Gilman, asst. engr., C.& N.W., Sioux City, Ia.; J. H. McClure, b. & b. mast., C.N.,

Moncton, N.B.; L. R. Morgan, transitman, N.Y.C., Syracuse, N.Y.; K. L. Miner, supvr. b. & b., N.Y.C., Beacon, N.Y.; E. E. R. Tratman, civil engr., Wheaton, Ill.; M. P. Walden, asst. supvr. b. & b., L.& N., Evansville, Ind.; and D. C. Yates, Jr., for. w. s., Alton, Bloomington, Ill.

Discussion

Considerable time was given to discussing the availability of automatic pumping equipment powered by oil engines. Many of the members had heard that such equipment is available and were desirous of getting information of the subject with the view to using this type of equipment where electric current is not available. R. E. Caudle (M. P.) stated that his road has such an installation which has been in service between two and three years and is giving excellent results.

The next item brought up for discussion was that of cleaning pipe lines. Mechanical cleaning and cleaning with acids were discussed at some length. R. C. Bardwell (C. & O.) who took charge of the discussion of this paper, explained the manner in which mechanical pipe cleaning is carried out, and stated that two companies have equipment available for this work. Several members inquired as to what methods can be employed where the material blocking pipe lines is not a hard scale but a relatively soft material that cannot be dislodged by the ordinary velocity of flow through the pipe. J. E. Tiedt (C. R. I. & P.) stated that he had been able to clean out soft accumulations in pipe lines as much as a mile long by using a roll of toilet paper, winding this up much as a kite string is wound, placing it in the pipe line and applying pump pressure. On another occasion, he fashioned a block of ice to fit inside a pipe line and was able to clean a line seven miles long of a similar accumulation, reducing the pump pressure from 135-lb. to 115 lb.

The question of safety in making high deliveries of water to locomotive tanks, that is, at the rate of 5,000 gal. per min. or more, was discussed at some length, including the desirability of some means for locking the water column spout in the manhole of the tank. It was brought out that where deliveries are made at this rate there will be a very severe reaction unless the spout of the water column is at right angles to the locomotive tank. It was stated that on one road it had been necessary to reduce the flow from 5,000 gal. per min. to a somewhat lower figure to insure safety to the man handling the water spout when filling the locomotive tender.

The Storage and Delivery of Bridge and Building Material

Report of Committee

R. E. Caudle
Chairman

THE report of this committee is based upon information furnished by its members, supplemented by additional information secured from a large number of railroads throughout the country, in an effort to obtain a nation-wide cross section of the usual methods of handling bridge and building materials. To secure this latter information, a questionnaire was forwarded to maintenance officers on 65 railroads in the United States and Canada, with a total of 223,000 miles of lines. Replies were received from 24 roads well distributed throughout the country, with a total mileage of 120,000 miles. Therefore, it can be assumed that the information furnished and forming the basis of this report is representative of present methods and practices employed in the storage and delivery of bridge and building materials generally.

The information obtained from the various railways under the several subheadings of the questionnaire is summarized in the following:

(1) Storage of Materials—Twenty roads, representing 94 per cent of the mileage reporting, store their bridge and building materials at central points. Four roads use local storage yards.

(2) Control of Materials—The stores department controls the materials on 20 roads; the maintenance department on four. Seventeen roads, representing 65 per cent of the mileage reporting, furnish the stores department with forecasts of materials required on an annual basis, four on a semi-annual basis, while four other roads, or 30 per cent of the mileage, furnish no forecasts. Twenty-two roads, or 92 per cent of the mileage reporting, have experienced no delays to work on account of deferred material deliveries.

(3) Policing—All roads reporting provide adequate fire protection for material stored, both at central points and in local yards, by employing municipal and company-owned fire-fighting equipment, by providing clean sites, by installing fences, and, when necessary, by employing company watchmen. Twelve roads, representing 45 per cent of the mileage, report some loss of materials from fire and theft.

The stores departments on 15 roads are responsible for the protection of materials while stored at central points and in local yards. Five roads divided this responsibility between the stores and maintenance departments. On four roads, the responsibility is entirely with the maintenance department.

On 16 roads, or 75 per cent of the mileage reporting, joint stores—maintenance checks are made "frequently"; on 2, such checks are made monthly; on 1, quarterly; and on another, annually. Eight roads report some loss of material on account of being kept on hand too long. The roads reporting losses feel that these losses could be reduced considerably, if not almost entirely eliminated, by a more intimate contact between the stores and maintenance departments.

(4) Emergency Materials—Twenty roads, or 94 per cent of the mileage reporting, keep emergency materials at strategic points. All roads keep them at division points. Five roads (of short mileage) keep them at central points. Eighteen roads report the stores department as controlling emergency materials. On six, such materials are controlled by the maintenance department.

Fourteen roads, or 67 per cent of the mileage reporting, keep an average of three spans of emergency materials on cars, with crews, at all times, while two roads keep five spans of materials with each pile driver. Ten roads keep from 5 to 20 spans of emergency materials at designated strategic or division points at all times. Fourteen roads depend upon drawing emergency materials, other than those kept with crews, from central storage points.

(5) Emergency Equipment—Twenty roads, or 94 per cent of the mileage reporting, store emergency equipment, such as pile drivers, derricks, hoists, and air and electric equipment, at central storage or division points when not in use by the crews. Four roads keep such equipment with the crews that use them at all times. Thirteen roads keep repair parts with their respective machines; two in local supply stations; six in stores; while three order repair parts direct from the factories. Thirteen roads report that they have no delays because of breakdowns; 11 report infrequent delays.

(6) Delivery of Materials—The stores department delivers materials to crews on 20 roads, or on 94 per cent of the mileage reporting. On four roads it is delivered by the maintenance department. No road reports shipping bridge and building materials in large quantities to local storage, to be reloaded subsequently for delivery to the crews as needed.

Nineteen roads, or 99 per cent of the mileage reporting, supply all crews with a limited amount of excess materials with which to make unforeseen repairs. Five roads (each of short mileage) do not so supply their crews. Trucks are used for the delivery of small lots of bridge and building materials to crews on 13 roads, or 60 per cent of the mileage reporting, with a considerable saving in time. Six roads use trucks for the delivery of materials in terminals, and find the practice quite economical. Five roads, or 35 per cent of the mileage reporting, do not use trucks, since they do not feel that there is any economy effected by their use.

"Local conditions, the amount of material involved, and the length of haul, are the determining factors in the use of work trains in lieu of way-freight trains in the distribution of bridge and building materials," say all of the roads furnishing information. They advise that all materials delivered to jobs and not used are promptly returned to the stores or maintenance department central storage points unless they can be transferred directly to another job without creating confusion.

Recommendations of Roads

According to answers received under the last subheading of our questionnaire—Recommendations, all roads favor the storage of bridge and building materials at central points. Twenty favor its control by the stores department. Four prefer control by the maintenance department. Nineteen roads favor furnishing the stores department with annual forecasts of materials. Five (short lines) feel that forecasts should be furnished semi-annually.

Eight roads, or 43 per cent of the mileage reporting, expect the stores department to have materials on hand to meet all requirements promptly, regardless of conditions. Twenty roads expect the stores department to deliver materials to the sites where they will be used. Four prefer that delivery be made by the maintenance department.

The Committee's Investigation Disclosed Widespread Use of Motor Trucks for the Delivery of Bridge and Building Materials

All roads recommend giving full and complete protection to materials against fire and theft, by every available means, employing watchmen to protect materials that are stored in large quantities at the site where they are to be used.

Nineteen roads report that from three to four spans of emergency materials should be kept on cars with crews. These roads recommend that from 10 to 20 spans of emergency materials should be kept at strategic or division points, or both. They say that the use of these materials for other than emergency purposes should be prohibited.

Twenty-two roads recommend that emergency equipment be stored at division points when not in service with the crews that use them. Twelve roads favor keeping repair parts for emergency equipment with the machines. Eleven roads favor the stores department maintaining a stock, while one believes that it is best to order these parts direct from the equipment manufacturers when needed.

To supplement the foregoing information received from maintenance officers, the committee made a canvas of the stores departments of the various railways to ascertain the general opinion and recommendations of these departments as to the storage and delivery of bridge and building materials. Questionnaires were mailed to the general storekeepers of 65 roads, and answers were received from 24, with a total mileage of 117,000 miles. The information contained in these answers is summarized in the following:

Central storage points are used for the storage of bridge and building materials by 20 roads. Four of these points are controlled by the maintenance department. Twenty roads report that accurate forecasts of creosoted material requirements are furnished by the maintenance department on an annual basis. Four report that such forecasts are made semi-annually; all of these roads say that the length of time of advance notice is entirely sufficient. Ten roads advise that two months is sufficient advance notice to procure untreated timbers; eight roads require three months; four roads require six months, and two say that they require 12 months.

On 13 of the 24 roads reporting, or 68 per cent of the mileage, the stores department is furnished by the maintenance department with a program of anticipated work on the larger improvement and replacement projects, arranged in order of precedence. All stores departments reporting advise that such information is, or would be, most helpful and convenient in arranging to have materials ready for delivery. Incidentally, they also say that in many instances this should result in a considerable decrease in the stocks of materials that must be kept on hand far in advance of the time that the various projects are to be undertaken.

Nineteen roads in the United States, totaling 88,000 miles, report an average bridge and building material stock (in 1939) of $5,044,000,

with annual disbursements of materials amounting to $9,218,000. As a whole, these roads are holding their average bridge and building stocks to 54.7 per cent of their annual disbursements. In addition to centralized storage, 15 roads keep specific bills of emergency materials at strategic points, while 9 keep stocks at division points. The stores department controls these stocks on 20 roads and the maintenance department controls them on 4 roads.

The average value of emergency stocks held at strategic and division points is $2,700. The value of these stocks at 200 points on the 117,000 miles of lines reporting is $540,000, or 10.7 per cent of the total of the average stocks maintained. Emergency points are located at intervals of approximately 600 miles. Each central storage point serves approximately 3,000 miles of road (or less) depending upon the mileage of the property.

All roads report that excess or unused materials shipped to jobs are returned to central storage points unless they can be transferred to other jobs without creating confusion.

From the foregoing review of the reports received from the bridge and building and the stores departments of the various railroads, it is evident that the methods employed in the storage and delivery of bridge and building materials on the different roads is not at wide divergence. Each road has an established system for performing these functions. Each road is, beyond doubt, entirely satisfied with its methods. This is indicated plainly by the individual recommendations received from the different roads.

In view of these facts, the committee hesitates to make definite recommendations, but it feels free to make comments and to quote in part from replies made by a number of maintenance officers. It believes that if these are considered without prejudice by the departments involved, they will perhaps serve as a nucleus to increase further the high efficiency that has been attained in the functions to which this report relates.

Quotations and Comments

"It may be observed that on this system the bridge and building department and the stores department are both sections of the operating department and are correlated sufficiently so that it is of little practical importance to the bridge and building department where the jurisdiction of the stores department ends." So states the bridge engineer of a 7,000-mile railway in the northwest.

"Fifteen years ago, our management went to centralized control of materials by the stores department. Many radical changes were necessary. The bridge and building and stores departments had the issue placed squarely before them with no opportunity for alibis. By friendly discussion and planning we have developed an excellent service that really functions. It fails only when some individual fails." This statement came from the general bridge inspector of a 9,000-mile mid-west system. "Piecemeal ordering of materials greatly increases the stores expense in handling, creates an abuse of car loading, and adds a burden to the operating department in switching and the movement of cars," this general inspector added.

Most of the Roads Questioned Recommended Storing Materials at Well Laid out and Equipped Central Points

The assistant bridge engineer of a 2,000-mile northwestern road wrote as follows: "After the completion of our annual inspection, about October 1 of each year, a list of the timber required is furnished the purchasing department by the chief engineer. The timber is then purchased, treated and placed in centralized storage. About June, direct shipments are made on requests received from bridge and building supervisors. All materials are received promptly when ordered, and without delay to the field forces, while formerly, considerable delay was experienced when storekeepers shipped materials from local yards. Flat cars should, by all means, be used for the loading of piles and heavy bridge timbers—for the safety of those employes who unload them, as well as economy."

"When two departments of a railroad fail to co-operate, the company is the main victim and the chief sufferer," states the assistant engineer of a 3,000-mile southern road.

The chief engineer of a 2,200-mile road in the mid-west wrote—"An annual inspection is made by the general inspector, accompanied by the division supervisor and other division officers, after which, a carefully prepared work sheet is made for each division. This work sheet is submitted to the management and, when approved, the material is ordered. The work sheet is divided into items, properly numbered, and opposite each item is shown the date on which the material will be needed. The material requiring treatment is ordered shipped to the treating plant, which, in turn, arranges to furnish the various items on the dates required." Incidentally, this chief engineer reports a total annual disbursement of bridge and building materials to the amount of $702,350, and an average general bridge and building stock of $463,500, or approximately 64 per cent of the annual disbursement.

An 8,000-mile mid-western system states that a forecast of anticipated requirements for bridge and building materials is furnished, but is not considered accurate due to changing business conditions which materially control appropriations. This system disbursed $1,308,000 in bridge and building materials in 1939. Its average stock was $693,000, 53 per cent of its annual disbursements.

A 3,000-mile southwestern line advises: "In June and July of each year, the supervisors and inspectors make a preliminary bridge and building inspection. In August and September the engineer of structures and division engineers make a field check of the preliminary inspection. From this checked inspection both the maintenance and improvement material requirements and work programs are made for the following year. Annual material requirements are set up in detail, divided into quarters. This statement, when approved by the chief engineer, together with the work program, which indicates the quarter in which the more important improvement and repair projects are expected to be undertaken, is turned over to the general purchasing agent and general storekeeper, usually not later than mid-October. There are never any delays to the bridge and building forces on account of the slow delivery of material; it is always ready for

delivery when ordered." On this road, the total disbursements of bridge and building materials in 1939 amounted to $972,500. The average stock was $234,410, or 24 per cent of the annual disbursements.

Funds that are tied up in materials held in storage in excess of an amount sufficient to meet requirements promptly, plus a reasonable surplus to meet emergencies that cannot be anticipated, is dead money, entirely out of circulation. On the other hand, any increased expenditures for labor as the result of not receiving materials when needed, is a wanton waste. Therefore, to eliminate as much of the dead money and wanton waste as possible, it becomes obligatory on the part of bridge and building departments to be consistent in the compilation of material requirements and to keep the stores departments fully advised as to dates for delivery, sufficiently in advance to permit the assembly of the materials. When this has been done, the responsibility for meeting the demand rests upon the stores department.

In 1930, the disbursements for bridge and building purposes on 19 roads, with a total of 88,000 miles of lines, were $12,500,000. The average stocks were $7,100,000, or 56.8 per cent of the disbursements. From 1930 to 1939, the average stocks decreased 28.9 per cent, while the annual disbursements decreased 26.2 per cent. In 1939 no complaints were made of delays incidental to a shortage of materials by the roads reporting. If the 19 roads reporting are representative of all of the railways in the United States, average bridge and building stocks would amount to approximately $14,325,000, with annual disbursements of some $26,175,000.

It is obvious that if the bridge and building departments of the railways would adopt a plan of making conservative estimates of material requirements on an annual basis and then divide them into halves or quarters; also prepare work programs indicating the half or quarter of the year in which the larger improvement and repair jobs would be done, and furnish this information to the stores departments some time prior to the first of the year, thereby permitting a spread of purchases over a longer period, a considerable amount of the frozen funds invested in average stocks held in storage could be thawed out without creating any waste in bridge and building department work because of the delayed delivery of materials.

With reference to the delivery of materials by truck, using the highways, an assistant bridge engineer on a northeastern system advises that: "Trucks operated on the highways have proved efficient and economical for delivering bridge and building materials and repair parts for water and fuel stations. It is more economical to rent trucks commercially than to buy them if there is insufficient work to keep railroad trucks busy full time." A bridge engineer on a large northwestern system states: "In line with the general need for labor saving equipment, we could use more trucks."

These two pertinent comments on the use of trucks are, generally the consensus of 19 roads that favor their use. The opinions of five roads that do not favor the use of trucks is expressed in the following comment of a chief engineer of a large southwestern road: "The use of trucks for the transportation of bridge and building materials is not considered either efficient or economical by this road." His road, however, has not used trucks for this purpose.

Conclusions of the Committee

From the information furnished the committee by a majority of the stores departments heard from, it seems that the annual forecasts of material requirements furnished them by the maintenance departments are viewed with more or less suspicion and cannot be entirely depended upon to reflect actual requirements. Therefore, in purchasing the anticipated annual requirements, the stock book is reviewed for several previous years and an average of the annual stock, as shown, is used, rather than being guided by the forecasts as furnished. Frequently, the nature of the bridge and building work varies considerably from year to year. In one year, for example, a larger part of the program may consist of heavy repairs and replacements to steel bridges and culverts, and extensive renewals or replacements of certain types of buildings other than those constructed of lumber, requiring for that year a much smaller amount of material for pile and frame trestles and for the maintenance of wood buildings. In the next year, the program may be completely reversed. The average "stock book" method of acquiring the next year's material could, under circumstances such as these, result in a most serious excess stock of material in one year, and an embarrassing shortage in another. The stores department has the "average stock" for an alibi, while the maintenance department has the excuse that its forecast of requirements was not given consideration.

Conservative annual forecasts, divided into six, four or three months, supplemented with a work program indicating in which period of the year the larger renewal and replacement projects are expected to be undertaken, should completely solve this problem by furnishing the stores department a much more accurate estimate of requirements than it is able to obtain by consulting the "stock book" for previous years. It seems rather extravagant to have materials ready for delivery in January that will not be used until July or later. On the other hand, it would not be economical to receive materials in July or later that should have been used in January.

Hardware, bolts, spikes, paints, etc., constitute a considerable part of the average stocks maintained and of the annual disbursements—perhaps as much as 25 per cent of the total. A structure cannot be completed without a full bill of hardware. Therefore, hardware becomes an item of as much importance as piling and lumber. Its shortage, no doubt, is the cause of more or less continuous controversy between the stores and maintenance departments. It frequently becomes a serious burden to train and station baggagemen. Most of the hardware required is of a standard type, easily and quickly procured. There should never be a shortage of it in the stores department, and not necessarily an excess stock. Hardware requirement controversies, at least in large measure, could be overcome by listing annual requirements; soliciting the co-operation of the stores department to bring its stock of each item up to 30, 40 or 50 per cent of the year's requirements, then asking it to keep a close check on the stock and to replenish each item promptly when it is depleted to 15, 20 or 25 per cent of the annual forecast.

Any habitual shortage or delay in the delivery of standard stock items of maintenance materials, either at general or outlying stores, could, no doubt, be overcome in large measure if the party who is being inconvenienced would handle the matter for correction through the proper channel with the general storekeeper. On the other hand, excess and slow-moving items at these points can, perhaps, be eliminated entirely by the annoyed party, if it will pursue a course along the proper route to finally reach the chief or maintenance engineer. Stocks of obsolete, off-standard materials and supplies that are not being requisitioned, could be disposed of readily if the stores department would send out a monthly or quarterly list of such materials to bridge and building supervisors, who, in turn, could look for places where these items could be used after obtaining proper authority,

rather than allow them to deteriorate.

The delivery of materials by the stores department to the sites where they are to be used is a most important matter. It requires constant vigilance by this department, the maintenance department and the operating department. If requisitions indicate the date when the material should be delivered at a site, the stores department will be in a position to request cars for loading sufficiently in advance of the delivery date to insure cars being furnished. When cars are loaded and waybilled, the stores department can assist the maintenance department in being ready to unload the cars by giving it early notice of shipment. Likewise, the operating department can be of material assistance in the prompt unloading and release of cars by notifying the division bridge and building supervisor when cars will be at the site. Supervisors, in turn, can render much assistance by notifying the operating department promptly when each car is unloaded.

The word "RUSH" on a requisition is anathema to most storekeepers —delivery dates, however, are a source of considerable satisfaction to them. Small lots of material requisitioned to be shipped to several points within the same general territory should, in so far as possible, be placed in one car, to be moved from station to station for unloading. When this is done, care should be used in loading to the end that the material may be unloaded in rotation without difficulty.

As pointed out earlier in this report, the maintenance departments on a few roads hold in storage and deliver bridge and building materials. The reason for this is because these roads are large users of creosoted piling and lumber and take into consideration the outstanding capabilities of their engineering personnel in the matters of timber inspection, seasoning, preframing and boring, treating, final delivery and use. However, those roads that leave these matters to the stores department, give this department the full advantage and co-operation of the members of their engineering department who are proficient in these practices. In the first instance, the purchasing and stores department co-operates with the engineering department. In the other, the engineering department co-operates with the purchasing and stores department. The ultimate results are, no doubt, the same.

General View of the Burlington System Stores Layout at Aurora, Ill., Showing the Main Storehouse in the Background

In Retrospect

Prior to the enactment of the Interstate Commerce Act in 1887, the operation of the railroads in this country was extravagant. The roads were unrestricted. There were numerous departments and sub-departments. Each department was independent of all others. Each maintained its individual store and purchased its materials and supplies. With the gradual extension of Federal supervision over their finances and rates, drastic retrenchments had to be made. It was, in time, determined that departmental stores and purchases constituted one of the great extravagances of the system.

In the years following the Commerce act, as a measure of economy, the numerous departmental stores and purchasing departments were set aside and replaced by a system stores department in charge of a general storekeeper. These general storekeepers were authorized to purchase, store and deliver materials and supplies for all departments of the road.

To this system, all other departments, naturally, were antagonistic. For some years their new officers, whose duty it was to make purchases advantageously and to see that materials were not wasted, were in a most difficult position. They survived mainly for the reason that from the beginning of their operations they were in a position to prove the economy and efficiency of their system. Under the old system, purchases were made at the discretion of the head of each department, perhaps regardless of price and quality, and frequently in vast quantities. The materials and supplies were stored at various places and were not accounted for in detail. In many instances, much of the material was not used and in time deteriorated into a total loss to the road. Under the new system, purchases are made by the purchasing agent on a competitive basis, quality and durability considered, in sufficient quantities to meet current requirements. The materials and supplies are stored by the general storekeeper and are so delivered that their disposition is accurately accounted for.

Conclusion

If the information furnished this committee by both the maintenance and stores departments of 24 different systems, constituting 50 per cent of the railway mileage of this country, is accurate, co-operation between the stores and the bridge and building departments has almost reached the apex of efficiency; apparently, to such an extent that it matters little to either department where the jurisdiction of the other ends. However, the recommendation of a chief engineer of a western system as to how to improve the service of the storage and delivery of bridge and building materials— "Make bridge and building men more dollar conscious" is indeed a most appropriate suggestion.

Committee—R. E. Caudle (chairman), asst. engr. structures, M. P., Houston, Tex.; W. A. Batey (vice-chairman) sys. bridge insp., U. P., Omaha, Neb.; Van S. Brokaw (vice-chairman), asst. engr., C. M. St. P. & P., Chicago; M. D. Carothers, div. engr., Alton, Bloomington, Ill.; H. M. Church, gen'l. supvr. b. & b., C. & O., Richmond, Va.; F. A. Haley, bridge insp., N.Y.C., Brewster, N.Y.; H. M. Harlow, asst. supvr. b. & b., C. & O., Clifton Forge, Va.; F. W. Hillman, asst. engr. main., C. & N. W., Chicago; J. S. Huntoon, bridge engr., M. C., Detroit, Mich.; L. Koehly, ch. carp., C. M. St. P. & P., Ottumwa, Ia.; D. A. Manning, supvr. b. & b., C. & N. W., Chicago; C. D. Malloy, for. b. & b., M. P., Piedmont, Mo.; F. A. Scites, supvr. b. & b., C. & O., Huntington, W. Va.; and Wm. Wilbur, bridge insp., C. & N. W., Chicago.

Discussion

The question of the sequence in which materials are received appeared to be of general interest to the members and was discussed at considerable length. George Rear (S. P.) emphasized the desirability of regularity in the bridge and building program; that is, that such programs should be put on as nearly a uniform basis from year to year as is practicable, since it will permit better maintenance of the structures and at the same time assist the stores department in its procurement efforts. He stated that on the Southern Pacific it is customary to notify the stores

department specifically when unusual material or unusual quantities of any class of material will be needed, this being in addition to the normal notification of probable requirements. When requisitions are made, the date of delivery wanted is specified. H. M. Church (C. & O.) stated that on his road, the system of notifying the stores department regarding material requirements is very similar to that on the Southern Pacific, with long-term programs worked out tentatively, and 12 to 16 months advance notice of requirements being given the stores department. In the case of both roads, however, it was pointed out that this notification is not intended as authority for shipments, these shipments being made only on requisitions specifying the date of delivery. W. A. Beatty (U. P.) stated that the motive behind all systems of doing work is to get it done at the smallest possible expenditure. This cannot be accomplished, he said, unless full cooperation is extended by the departments involved, which includes the shipment of materials in the sequence required and delivery on the dates needed.

J. S. Gabriel (D. & R. G. W.) called attention to the fact that material on hand presents a difficult problem for both the stores department and the railway as a whole, since it cannot be used for any purpose other than that for which it was ordered, whereas the money which its purchase represented could have been used for any purpose for which the exchange of money can be used. Further, he called attention to the fact that standardization will reduce the amount of stock necessary to be carried and pointed out that the cost of carrying material in stores department stocks amounts to about 18 per cent of the value of the material. He then said that if material stocks can be reduced $1,000,000, even though this amount of money may not always be available for other use, it is always earning 18 per cent.

Mr. Rear made a special plea for the use of second-hand material for making running repairs to pile and timber trestles that have been in service for a considerable time. He stated that on the larger roads there is always usable second-hand material available for such applications and that the structures will generally be benefited by using the second-hand material rather than stiffer new material. W. A. Hutcheson (C. & O.), in explaining the system of advance notice to the stores department in use on the Chesapeake & Ohio, stated that for the information of the stores department, bridge and building supervisors make semi-monthly statements of the materials they expect to use during the next 30 days, giving the date it should be shipped and the point of delivery, this being in addition to the dates of delivery specified on the requisitions. This is done, he said, to avoid earlier shipment in case it had not been possible to get the work started at the time expected, or to accelerate shipments where the work is started earlier than expected.

Considerable time was given to a discussion of the advantages of selling abandoned buildings with a view to having them removed from the right-of-way rather than to undertake the expense of dismantling them. It was brought out that in some cases valuable second-hand material can be obtained from such dismantling operations, whereas in other cases it will be difficult to salvage material that will be suitable for secondhand use. For these reasons, it was pointed out that considerable judgment should be exercised in determining the method to be followed in disposing of buildings no longer needed.

Repair and Renewal of Ballasted-Deck Bridges

Report of Committee

MAJOR reference is made in this report to treated wood bridges and trestles. Ballasted-deck pile trestles were first erected about 40 to 45 years ago and were expected at that time to have a life of 25 to 35 years. Many structures have already greatly exceeded that expectation and some of them will, no doubt, give 50 years of service.

This type of structure has proven very satisfactory, both because of its low maintenance cost and because of the improved riding qualities which it affords. Countless bridge structures now in service indicate that a ballasted-deck pile trestle requires very little maintenance for many years following its construction. However, due to differences in the quality of the timber used, combined with construction defects, such as the improper treatment of field cuts and bored holes in piling and decks, many of the earlier bridges of this type are requiring minor repairs to obtain the full life of the structure as a whole.

W. A. Sweet
Chairman

The first ballasted-deck pile trestle built on the Santa Fe was driven during the winter of 1898-1899. This structure is being renewed completely during the present year after being in service nearly 42 years. As built originally, this bridge consisted of 73 bents of five long-leaf yellow pine piles per bent. The deck material was of Texas pine; the caps and main stringers were 12-in. by 12-in. timbers; while the outside stringers were 10-in. by 10-in. timbers. All material received a 10 or 12-lb. full-cell treatment of creosote oil and good penetration was obtained.

Repairs made to this structure in the past consisted of renewing about 48 per cent of the original caps. The necessity for changing these caps was due partly to the fact that the five-pile bents provided insufficient bearing area to carry the heavy power moved over the bridge, which resulted in some of the caps being crushed over the piles. Nine of the original piles were replaced and 11 helper piles were added. In 1937, two 12-in. by 12-in. by 14-ft. and seven 12-in. by 12-in. by 28-ft. stringers were changed out. Considering that this bridge was designed and built 42 years ago, it is felt that very satisfactory service has been obtained from it.

When repairs to a ballasted-deck bridge become necessary, they present a much more difficult problem

than do repairs to an open-deck bridge. To determine when repairs are necessary, and the extent of the repairs needed, calls for a careful and complete inspection by properly designated officers, preferably a general foreman or supervisor of bridges, and such others as may be required. The judgment of the inspectors, in addition to following fixed inspection rules, is usually sufficient in most cases.

Rules for Inspection of Treated Ballasted-Deck Trestles

Treated ballasted-deck trestles require very little inspection for a number of years after construction. Regular inspections are necessary, however, to insure against broken timbers and fire hazards, and to see that bents are not weakened by scour from flood waters. After about 15 or 20 years, it is well to determine the condition of the timber by sounding adjacent to the bearings with a hammer weighing about two pounds. Piling usually shows first signs of failure directly under the cap at the cut-off, resulting primarily from failure of the field treatment to provide adequate protection. Decay may also be found at brace bearings where holes, bored through the piles, were not properly treated. Piles may also be found decayed in the center, several feet above the normal water line, as the result of water penetrating to the center through weathering cracks during high water periods.

If sounding indicates that a timber is more or less hollow, a thorough investigation should be made with an auger or increment borer to determine its true condition accurately. If it is found that decay has already taken place, the degree of decay will determine the frequency of future inspections. If, on the other hand, the sounding test indicates sound timber, future tests may be made every three to five years until the sounding test indicates decay; then the boring test should be made.

Under usual conditions, a complete boring test of all timbers will not be necessary until the structure is about 30 years old. After such a test, all holes should be treated with hot creosote oil and plugged with creosoted wood plugs and sealed over with pitch or sealing compound. Timbers should not be examined with a pointed bar, as the use of such a tool will damage them. The heavy crust of creosote-soaked earth around piles at the ground line should not be disturbed, as this provides added protection at the ground line where decay usually starts.

Caps should be examined closely for splits, crushing over bearings and spreading. One should use a sounding maul and an increment borer when signs of decay are found. Crushing over the piles is quite often an indication of decay in the tops of piles, which reduces their bearing surface to a narrow ring or shell of solid wood which cuts into the bottom of the cap. Braces should be inspected along with other pile bent material. Where silt has been deposited around the lower ends of braces, they may be found decayed. The stringers on ballasted-deck bridges generally show first signs of failure at their bearings on the caps and directly under the deck boards. In decks having the solid-stringer type of construction, individual timbers will often warp or develop a permanent set in the center of the panel, causing them to sag an inch or more lower than adjoining stringers.

When it becomes necessary to bore stringers for inspection, the holes should be bored from below insofar as possible to eliminate the possibility of their holding water. In some instances it may be necessary to remove the ballast and to bore through the deck boards into the stringers to determine their condition. All holes, whether bored from above or below, should be treated and plugged. A pressure gun is needed to treat properly vertical holes bored from below. An accurate record of all timbers bored should be made and kept on file, both to determine the repairs necessary at the time the inspection is made and for reference in making future inspections.

Other Types of Ballasted Decks

After about 25 years, depending somewhat on drainage conditions, the timbers of ballasted decks on steel spans may begin to show decay and crushing over the bearings, and weakness under traffic. The timbers should then be bored from below at about a 45-deg. angle over the bearings, because any decay in the timbers will usually be found at these points, especially if they have been gained out for rivet heads and were not properly treated where cut. Decay may also be evident around the hook bolts attaching the deck timbers to the steel. On some decks it may be necessary to remove the ballast in places and make the inspection from the top.

In the case of concrete ballasted decks on steel spans and concrete ballasted-deck bridges, the parapets usually deteriorate first. This deterioration, as well as that on the bottoms of the slabs, which usually is next in order to appear, is easily detected and can be followed closely at the time of the regular masonry inspections. Discoloration is an indication that water action is taking place within the body of the concrete. A clear ring of the concrete resulting from a sharp blow with a hammer is a good indication of soundness.

Wrought Iron Deck Plates are Being Installed by Some Roads With the Expectation That Longer Service Life Will Result

In the case of steel plate ballasted decks, to guard against warping or buckling and eventual rupture, the side plates should be designed for the vertical and lateral loads that they must receive through the ballast. Steel plate ballasted decks ordinarily do not require attention or inspection for serious corrosion until 25 to 30 years after installation. Then the ballast should be dug out at a few points and the bottom plate inspected. The necessity for watertightness may require a much earlier inspection and repair date. Wrought iron deck plates are being installed by some roads with the expectation that longer service life will result from this material than from the steel so generally used.

A structure should be carried with repairs just as far as such repairs can be justified economically and consistent with safety. The location of the structure and the traffic which it carries are factors which must govern the situation to a great extent. Reports from several roads indicate that all ballasted-deck pile trestles renewed to date were renewed because of the condition of the substructure rather than the condition of the deck. Therefore, every means should be employed to keep the sub-

structure safe until the longest possible life is obtained from the superstructure. It seems to be generally agreed that treated material, either new or good second hand, should be used, except perhaps in making temporary repairs, pending complete renewal within the near future.

The repairs most generally found necessary will include the occasional renewal of a cap or two; double-capping to obtain good bearing on piles which have become hollowed out by decay; the reinforcing or renewing of defective stringers; and repairs to bents. Repairs of the latter type can be made by cutting out defective piles and replacing them with posts resting on the pile stumps, or, by placing frame bents where conditions warrant, using either squared timbers for the new bents, or making the framed bents from the sound piles that remain and other piles or timbers added to complete the framing.

The substructure can often be greatly stiffened by placing additional bracing and by the use of Teco Timber connectors between the piling and bracing. These connectors are being used quite extensively by many roads. Those used most frequently in trestle bracing in reconstruction and repair work are the toothed-ring type and the flat and single-curve spike grids. These are used mainly to increase the efficiency of the bracing. One road has used toothed rings in placing stub piles in ballasted-deck bridge repair work.

The Chicago, Milwaukee, St. Paul & Pacific arrests checks in caps by the use of Giant Grip dowels driven into the caps. It also makes repairs to broken stringers by placing a helper stringer on each side, and securing the three pieces together with Giant Grip dowels.

Outside stringers are renewed in kind. In changing a cap in a ballasted-deck bridge, especially one with a solid stringer floor, great difficulty is generally experienced pulling the drift bolts that hold the stringers to the caps and the caps to the piles. Some roads have devised other methods of anchoring the caps to the piles and the stringers to the caps, eliminating the use of drift bolts, which, no doubt, greatly simplifies the work when repairs become necessary.

Partial renewals of ballasted decks on steel spans and timber trestles alike are obviously so uneconomical that they should not be considered. Many decks have been in service 35 years or more without repairs, and when repair becomes necessary, complete renewal should be made. The necessity for complete renewal may differ to some extent for each structure and be affected by the conditions surrounding each particular structure and the traffic it has to carry.

While decay in the timber is the most frequent reason for the complete renewal of a bridge, increased live loads, in many cases, may have to be considered also. A study of the following factors should be made to determine the proper time for complete renewal: the physical condition of the timber; necessity for a structure of higher rating; the cost of extensive repairs; and the cost of the new bridge. A high trestle across a stream subject to flood waters cannot be carried safely for as long a period as a low structure in a location not subject to such conditions.

Making a Complete Renewal

The procedure for making the complete renewal of a ballasted-deck bridge depends to a large extent upon traffic conditions. If the structure carries a track that can be taken out of service, the procedure will be the same as for constructing a new bridge. Where traffic must be maintained, the best procedure is to first remove all of the ballast and all of the stringers except eight of the best ones, which should be placed four under each rail, forming two chords. The stringers in each chord should be bolted together to prevent their shifting or spreading. Blocking should be placed between the ties and these chords, using old stringers placed longitudinally directly under the rail.

Before starting the driving of the piles for the new bridge, the bents should be carefully staked out to insure the proper spread of piles in the bents, as well as accurate lengths of the panels. Holes should be bored in the ground sufficiently deep to insure holding the piles in line in the bents. After the piles have been driven and the bents cut off and capped, a number of panels of the old deck should be removed and the deck of the new bridge placed. The length of deck to be changed at one time depends upon the time available between trains.

Changes in the grade of the track and in the depth of timber in new decks will sometimes make a difference in the procedure, which will have to be worked out to the best advantage for each case. The Missouri Pacific advises that all decks for bridges more than three panels long are constructed on a temporary support adjacent to the old structure and are then jacked under the track after the old deck has been removed. In this method, they report a saving in labor costs as well as less delay to train operations.

Renewals on Steel Spans

In renewing timber ballasted decks on steel spans, first remove the ballast curbs so the deck timbers can be removed, without attempting to salvage the old ballast. As the old deck is removed, lay the new timbers immediately and bolt them in place. Block the track up with sawed ties or with the old deck timbers removed, placing them longitudinally under the track ties, one line under each rail. Dump new ballast and surface the track. As all of this work has to be done between trains, the time available will determine the number of feet of deck that can be replaced at one time. It is not essential that the new ballast be dumped before letting trains over, as the blocking ties or timbers under each rail will carry the track. A power crane should be used to handle the timber and the ballast.

Treated Ballasted-Deck Bridges, Built to the Highest Standards, Will be Good for at Least 50 Years, According to the Committee

The Milwaukee reports that employing this procedure on a number of jobs where concrete slab ballasted decks were being replaced with creosoted timber decks, they found that it requires an average of 1¼ man-hours per foot of deck to remove the old concrete slabs and 3 man-hours per foot to place the new deck.

Most roads make no special provisions for the drainage of ballasted-

decks of trestle bridges or of timber decks on steel spans, other than to allow 1/8- to 1/4-in. openings between deck boards to allow water to drain through. The Santa Fe places 13/16-in. wood shims under the ballast curbs at each bolt location to allow water to drain out. The Missouri Pacific uses a similar plan.

Drainage systems in concrete-slab and steel-plate ballasted decks have not proven satisfactory in many cases, generally because weep holes become clogged. A number of roads, in the case of steel-plate ballasted decks, are now using a half-round perforated drain placed longitudinally along each side of the track, sloped laterally and longitudinally to the track. On buckle-plate ballasted floors, where weep holes have become clogged, the openings can be enlarged to a drain of 2½ in. to 3 in., and special drain castings installed.

Effect of Ballast Lift

Some roads have disregarded the possible overloading effect of the increased dead load due to a ballast lift and consider this of little importance in relation to the steadily increasing live load. In connection with this question, a review was made of the design for the standard pile-ballasted-floor trestle used on one of the western railroads. The design data for this trestle as designed originally (1910-1911) were as follows:

- Live load on bridge—E-50; Dead load 2200 lb. per ft. of track.
- Ballast—Screened stone; depth 1 ft. 2 in. below base of rail.
- Ties—6 in. by 8 in. by 8 ft., spaced 1 ft. 6 in. centers.
- Timber floor planks—3 in. by 8 in. by 14 ft., with ½ in. space between planks.
- Intermediate stringers—8 in. by 16 in. by 14 ft. 6 in., eight stringers per track.
- Outside stringers—6 in. by 16 in. by 14 ft. 6 in.
- Guard rails—8 in. by 8 in., separated from floor planks by cast iron separators 1 in. thick, 5 in. wide—three separators per span.
- Caps—12 in. by 14 in. by 16 ft.
- Piles—6 per bent, 13 ft. 6 in. c. to c. of bents.
- All timber creosoted.

In this review of the design, the original E-50 loading was assumed with the longitudinal distribution of live load over two ties and transverse distribution over 9 ft. 2 in. This distribution was used for figuring loads on the floor planks. No allowance was made for impact.

The effect of additional ballast 12 in. deep, or a total depth of 2 ft. 2 in., was considered as applied to different members of the trestle. The results of the review of design are given in an accompanying table, which shows that additional ballast, 12 in. deep, produces stresses in the stringers and piles that approach their limits. The stress in the stringers reaches 1600 lb. per sq. in., which is equal to the allowable working stress of 1600 lb. per sq. in. for select grade Douglas fir, ordinarily used for stringers. The load on each pile reaches 15 tons. This higher loading may be allowed on the piles, depending upon their bearing capacity, determined by test, and upon their penetration.

Railway Engineering and Maintenance Cyclopedia, Page 503, refers to some cases where the depth of ballast on bridges, acquired through successive lifts over a period of years, has reached a depth of 4 ft. This depth of ballast surely is excessive, and that it produces stresses considerably above the allowable working stresses for structures designed for 14 in. to 18 in. of ballast, is shown in the case of the trestle reviewed in the foregoing.

The proper solution for the lift of the ballast seems to be in limiting the increased depth of ballast to an additional height of not more than 12 in. If there is need for an additional raise of the grade of the track over the bridge, the additional raise can be secured by providing shims or false caps at the bents. This procedure will not put additional overload on the bridge. It is realized, of course, that to place false caps for a bridge of considerable length will call for jacking up the spans for the entire length of the bridge, a procedure that may cause delay to traffic. However, safety, as measured by the strength of the members of a bridge, may call for the adoption of this procedure instead of putting additional extra ballast on a bridge.

Make necessary repairs to old structures to insure safety until renewed, using treated material, either new or good second hand.

In making bridge renewals, select materials carefully. Use preframed timbers in so far as possible. Eliminate all unnecessary holes or drift bolts. Give special attention to the field treatment of all cuts and holes. If these measures are followed, ballasted-deck bridges constructed today will be good for at least 50 years.

Increased Stresses in Trestle Members Due to a 12-in. Ballast Lift

Members	Size of Timber		Original Design L.L. = E-50 Ballast = 1'-2"		Reviewed Design L.L. = E-50 Ballast = 2'-2"	
	Nominal	Actual	Unit shear	Fiber stress	Unit shear	Fiber stress
Floor plank	3"x8"	2¾"x7½"	53 #/□"	515 #/□"	56 #/□"	642 #/□"
Stringers	8"x16"	7¾"x15¾"	113 #/□"	1460 #/□"	123 #/□"	1600 #/□"
Caps	12"x14"	11½"x13½"	89 #/□"	800 #/□"	97 #/□"	990 #/□"
Piles	6 Piles per bent		Load per pile = 13.4 T.		Load per pile = 15 T.	

Committee—W. A. Sweet (chairman), gen'l. for. b. & b., A. T. & S. F., Newton, Kan.; L. G. Byrd (vice-chairman), supvr. b. & b., M. P., Poplar Bluff, Mo.; F. A. Baker, for. b. & b., S. P., Springfield, Ore.; F. G. Campbell, asst. ch. engr., E. J. & E., Joliet, Ill.; A. B. Chapman, office engr., C.M.St.P.& P., Chicago; R. W. Cook, gen'l. bridge insp., S. A. L., Norfolk, Va.; F. G. Elmquist, bridge insp., C.M.St.P.& P., Chicago; R. L. Fox, rdm., Sou., Alexandria, Va.; B. H. Goodwin, supvr. b. & b., Sou., Atlanta, Ga.; H. A. Gerst, asst. engr., G. N., St. Paul, Minn.; G. H. Holmes, supvr. b. & b., M. P., Falls City, Neb.; A. C. Jones, supvr. b. & b., Sou., Wilton, Ala.; A. E. Kile, b. & b. carp., S. P., El Paso, Tex.; J. B. Lodeski, asst. gen'l. bridge insp., C. & N. W., Chicago; Alex Sirel, dftsman, C. & N. W., Chicago; A. C. Tanner, supvr. b. & b., N. Y. C., Weehawken, N.J.; R. A. Whiteford, div. engr., C.M.St.P.& P., Ottumwa, Ia.

Discussion

S. T. Corey (C. R. I. & P.) inquired if it might not be possible to strengthen economically the existing stringers of ballasted-deck trestles in which the stringers are lapped over the bents, by adding an extra 3-in. by 8-in. member to the bottom of each stringer, and if so, how the strengthening members should be applied or fastened to the stringers. R. A. Van Ness (A. T. & S. F.) thought Mr. Corey's suggestion was worth trying, and suggested that possibly Teco alligator rings might be used, although he recognized that their use would have the disadvantage of crushing the wood fibres where they are applied. He also suggested that this method, if tried, might be followed by deflection tests to determine the effective increase obtained in the strength of the bridge.

In answer to a question raised by F. R. Spofford (B. & M.) concerning the equipment used in treating bored test holes with hot creosote before they are plugged, Chairman Sweet replied that a pressure-type gun is used and that the far end of the hole in plugged with a screw-type plug so that considerable pressure can be applied. He added that in the case of holes bored through two adjacent pieces, such as piles and sway braces, their practice is to bore all holes with the braces in place, and then to swing

the braces aside and pressure-treat the holes in the piles. The braces, he pointed out, are usually so well impregnated in their initial treatment that holes bored in them in the field require only swabbing with creosote. In some cases, he said, the gun is equipped with a special screw nozzle which extends through the brace and into the pile, thus making it possible to pressure-treat the hole in the pile without removing the brace.

President Bechtelheimer raised a question regarding methods of providing anchorage for stringers on ballasted-deck trestles, which would permit stringers to be renewed without disturbing the deck. W. Walken (C. N. R.) and L. G. Byrd (M. P.) said it was not necessary to use drift bolts through the stringers; that they had used structural angles or splice bars bolted to the stringers and caps to provide the necessary anchorage.

G. E. Boyd *(Railway Engineering and Maintenance)* inquired if the committee had any information concerning the possibility of renewing the decks of ballasted-deck bridges without slow orders. Mr. Bryd said that the use of slow orders for short periods of time was usually necessary in this type of work, although the decks of small bridges in some cases could be renewed between trains. Chairman Sweet cited a case in which the deck of a bridge 160 ft. long, consisting of three deck plate girder spans, was renewed in five hours. In this work, he said, two track gangs were used to help the bridge gang, and a first lift on the new ballast was completed within five hours, at which time a train was allowed to pass over the bridge at a speed of 10 m.p.h. The second lift was then completed and a 30 m.p.h. slow order was allowed to remain in effect for 24 hours.

The Inspection of Buildings to Formulate the Maintenance Program

Report of Committee

L. E. Peyser
Chairman

AS THE members of this association well know, the inspection of bridges, trestles and culverts is done in a systematic, thorough and detailed manner on every railroad. The safety of train operation depends to a considerable extent upon these inspections, which determine the repairs and renewals necessary during the year. During the last ten years, with their curtailed maintenance allowances, it has been necessary for the railways to concentrate on the inspection of bridges, trestles and culverts in order to avoid interfering with the operation of trains, either from the standpoint of safety or slow orders.

The inspection and consequent repair of buildings has, therefore, been curtailed to a great extent with the thought in mind that this is one place where maintenance expenditures can be cut down. It must not be overlooked, however, that even when reduced to the lowest possible level, the maintenance of buildings comprises a major expenditure and is, therefore, entitled to the same thorough study as other items on the maintenance program. A study cannot be properly made and a budget program formulated without the actual inspection of buildings to gain some idea of the work that must be performed and the amount of money that will be required and to permit the proper and orderly formulation of the field work. The preparation of a program based upon careful inspections should provide the greatest improvement in the most buildings at the least possible expenditure.

The responsibility rests with the head of the bridge and building department (the supervisor, master carpenter or other person who fills this position) for the safe and proper maintenance of buildings. He must know at all times that each building is in condition to meet all the requirements of safety and protection of contents (in persons, goods or equipment), as well as of the building itself.

Information regarding the condition of a building can be secured only through periodic and detailed inspections by persons possessing a full knowledge of what is required. This work calls for good judgment, since it is not unusual to find that defective details, which on cursory inspection appear to be of great importance, are shown, on more careful investigation, to be not fundamental, while many defects that appear unimportant may in reality not affect one part alone, but the useful life of the entire structure.

Notwithstanding the fact that the head of the bridge and building department carries the primary responsibility for the condition of all buildings under his jurisdiction, he is not always in a position to formulate a complete building maintenance program, since there are other considerations which may either curtail or enlarge this program. The first consideration is the amount of money available for the maintenance of buildings and this is usually beyond the control of the local officers. Also, changes in operating conditions may dictate the necessity for heavier maintenance at some points, with corresponding reductions at others.

Office Representative Desirable

It is therefore highly desirable that a competent person from the general office representing the department most interested in developing the maintenance program, participate in the inspection that is made to develop a program for the work. It is not essential that this representative from the general office inspect every building each year, although this is desirable. The larger and most important buildings should, however, receive his attention. On the larger roads, where inspections require considerable time, because of the great distances between points, the line should be covered at least every two or three years. Changes in important buildings do not occur so rapidly that intelligent consideration cannot be given to the advisability of doing a particular piece of work if the last

inspection has been made perhaps two years ago.

It is desirable also that one man representing the general office be assigned to this inspection work instead of having several representatives do it. The data collected over a number of years then become of increasing value, and afford a good progressive picture of conditions over the entire road.

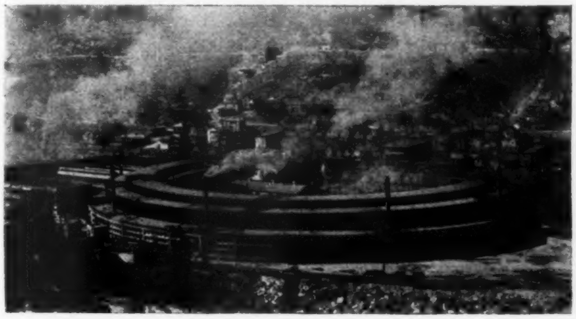
No inspection of a building should be made without including in the inspection party the foreman or superintendent of the department using the building. This man should be familiar with the problems of occupancy and of safety in connection with his work. If this practice is followed consistently, the users of buildings soon become aware of the importance of the inspection and may even point out work that would be beneficial and which might be included in a program, thus furthering the preparation of a more complete program which would not be disrupted by these details coming to light after the work is under way. In addition, this practice may lead to a considerable reduction in correspondence. A natural sequence of this is the development of a more cooperative and better feeling between those whose duty it is to make the best use of a structure and those who must keep it in good condition.

A representative of the fire prevention department should be of great help in building inspection work by pointing out desirable fire prevention needs, which, if incorporated with the work programmed, can be done most economically.

It is also essential that the inspection party be so constituted as to be able to make a relatively accurate estimate of costs on the ground, at least for the less complicated jobs. This is highly important, since there is little use in preparing an extended program, only to find that it must be curtailed materially to come within the budget.

The inclusion in the inspection party of the carpenter foreman who is familiar with the supervisor's ideas and methods, and who will eventually do the work, will be found to be of assistance in the making of these estimates. This foreman will not only do the work and spend the money, but must also be familiar with the work planned, and the better picture he has of the program the more economically he can handle it. Also, and not least, his presence will result in a highly desirable curtailment of letter writing.

While local conditions may be a factor in determining the best time for such inspections, it would appear that the autumn is probably better than any other season since all of the details may then be fully developed prior to the starting of the work in the spring. But more important than the time is the fact that the inspection should be carried out whenever possible as a continuous program. If this scheme is followed, the inspection can be speeded up through developing a familiarity with the methods, whereas an interrupted program requires the picking up of loose ends, and the ability to speed the work must be acquired after each interruption.



In the Case of Engine Terminal Buildings, It Is the Basic Structural Features, Not Appearance, That Require Detailed Inspection

Selecting Essential Work

Probably the most important sense to develop is that of seeing the essential items first—the ability to exclude the non-essentials and see only those that are necessary to the continued useful life of the structure in all that this implies. This is not always as simple or easy as it would seem, for it may be possible that after the absolute fundamentals are taken care of, the remaining work to be performed will vary widely as to importance. This can best be illustrated by a comparison of buildings of widely divergent uses, such as an engine house and a station building in any good community. In the first structure, a sound foundation and engine pits in good repair are of primary importance, followed closely by consideration of the roof structure, the walls, smoke jacks, roofing, siding, sash and doors in approximately that order, with the general appearance of the building a bad last. Such a building is purely utilitarian and not for beauty.

A station building, however, after its basic structural condition is taken care of, must be considered from the standpoint of appearance; civic pride enters into the picture and appearance is of great importance. A phase of the problem that must be given great thought in this case is that of safety for the public, people being notoriously careless. A step in the wrong place or of the wrong height, a loose or damaged floor board, a slivered settee, a door swung the wrong way, or any one of innumerable other small details may be the cause of accidental injury to person or property, leading to recovery for damage and adverse publicity.

In the same way that bridges and trestles have certain fundamental members which must be sound to make them safe, buildings have fundamental parts which should be inspected and examined first. Various portions of a building vary in importance and your committee has listed them in what it believes to be their order of importance.

Foundations

Regardless of what else is done to a building, if the foundation is bad, the building itself is still bad; no matter how much work is done above the grade line, it cannot prevent destruction of the building before fulfillment of its life expectancy.

If the foundation is of untreated wood, consideration should be given to replacing it with permanent material; if the structure is not worth the cost thus involved, the use of creosoted timber should be considered. This is particularly true in those areas where termites are a problem for it is only through careful inspection that this cause of destruction can be discovered, and the necessary steps must be taken for its correction as soon as possible.

Roofing

A leaking roof is bad, not only because of the possibility of damage to the contents of the building, but also because of the fact that if even a small amount of water finds its way into a building, it starts destruction which is insidious in that while it is not immediately apparent, it eventually causes serious failure of the structural parts to develop with some degree of suddenness. In buildings with finished interiors, costly damage is done to paint, plaster, furniture, etc., before failure occurs. The

inspection of a roof should always include the careful examination of flashings, gutters, leader pipes and leader heads, since leaks in an otherwise fairly good roof will occur first at these critical points.

Floors

From the standpoint of safety to persons, flooring is highly important and its maintenance should be kept up most carefully. A loose, slivered or badly worn wooden floor; a spalled concrete floor; or an uneven asphalt, wood block or brick floor, is sure to claim its victims in personal injuries, while the necessity for caution by workmen to avoid accidental injury will slow down their work and lead to increased costs for their operations. Increased costs for trucking and claims for damage to goods which cannot stand rough handling are certain to result from operation over poor floors.

The inspection of floors of wood construction should extend to their substructure and foundations, since the best of surface materials cannot long remain satisfactory on a springy support. The hiding of a bad condition by the application of a new surface is not maintenance. Consideration should be given to changing out wood floors at grade to concrete or some other form of permanent material.

Framing or Structure

In a building of honest design and construction, failure of structural parts may sometimes be attributable to lack of maintenance of other members or details over a number of years. A poor foundation overstresses these members; a leaking roof admits water to structural joints, with consequent rot and rust; lack of paint permits the rusting of nails, bolts, rods and other metal parts. Therefore, an inspection should include a check not alone of the main members, but also of joints and fastenings.

In buildings subjected to smoke or gas conditions, metalwork should be rigidly inspected, particularly the roof structure where spans are relatively large. Long neglect of roof trusses not infrequently results in sudden failure, which usually occurs at the most inopportune time, such as at the height of the heaviest snowstorm of the year.

Plumbing and Heating

The necessity for repairs to plumbing usually advertises itself, insofar as the visible parts are concerned and they are, therefore, usually well taken care of, not accumulating for any appreciable length of time. An inspection should, however, trace main lines through the building as failures frequently start with small leaks that become noticeable considerably in advance of major breaks.

Heating systems are probably inspected best in the spring when repairs can be made in an orderly unhurried manner and not left until a sudden unseasonable cold spell finds the plant out of service and, possibly, with some vitally needed part unavailable on short notice.

Millwork, Sash, Doors, Trim, etc.

These items, while apparently of minor importance, are actually among the major items of cost in some types of buildings. They are often neglected and owing to their inherent fragility, are the first parts to suffer from normal use and from deferred painting. Failures from the latter cause, once started, are progressive and no amount of later surface protection can prevent accelerated disintegration.

The question of a change in materials should be carefully weighed. Frequently, economies can be effected by replacing inferior materials with better materials, as for example, the substitution of treated wood for untreated wood; steel sash for wood; thicker glass, or where vibration or other conditions of service make it desirable, wire glass for plain glass.

In buildings having roof overhangs of wood construction, the millwork, gutters, etc., must be watched carefully to avoid allowing defects to lead to the destruction of the interior framing. Also, light, loose sash, missing glass, and doors not quite tight, result in enormous heat losses, with consequent inadequately heated areas or a marked increase in the consumption of steam or other costly heating mediums.

Exterior Walls

Exterior walls, when constructed of any of the various forms of masonry, are usually long-lived, but even so, they may be subject to defects or failure which, if neglected, can materially reduce the life of a structure. Brick walls, particularly of older buildings, constructed before the present cement-tempered mortars were used, sometimes show disintegration of mortar joints and pointing them up with a strong, cement-tempered mortar will result in longer life. When this condition, together with any considerable number of "salmon" or otherwise poor quality brick are found together, the problem is difficult of solution. In some cases it has been found economical to "gunite" the surface.

The joints in stonework are subject to the same defects and can be treated similarly. Generally, stone does not display the weaknesses of bricks, but occasionally individual stones develop defects which can be corrected individually by their replacement or by surfacing with cement mortar.

Concrete, unless composed of poor materials, is not subject to serious defects or disintegration, but when this does occur, a careful inspection must be made to insure the removal of defective materials and to so seal the surface as to prevent penetration of water, which otherwise will result in the destruction of the reinforcement.

Metal sheathing is at best an impermanent material and the only hope of its lasting for any length of time is to keep it well coated with paint. Unfortunately, it is often used on buildings where smoke or gas conditions are severe, and unless it can be protected on both surfaces, it will rust out just as quickly from within as without. It is necessary that fastenings be examined carefully to insure that the sheets are secured in place. There are few things more dangerous than a sheet of corrugated steel which is loosened by a high wind and sent sailing through the air. Wood can be protected only by paint, and the lack of it in time results in rusting nails and loose pieces of timber. Where the painting is long deferred, examination should be made to disclose where renailing is required.

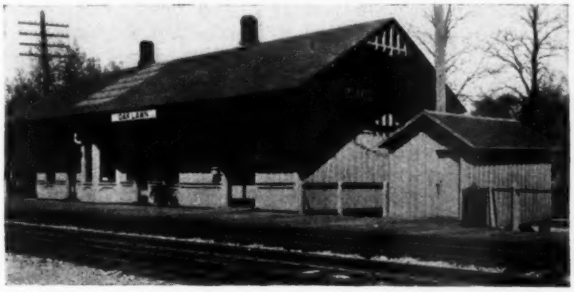
Painting

Unfortunately, the first thought with regard to paint is that it is a material used primarily for appearance. However, this is not the case, as it is the one construction material that, for each dollar of cost, gives a dollar's worth of appearance and a dollar's worth of what is more important, protection of the material to which it is applied. Paint is often the last thing thought of in the preparation of a budget and the first thing eliminated when circumstances require curtailment.

In the development of the maintenance program, painting should be approached in the most keenly analytical manner. We all like to see our buildings spick and span and at all times shining with new coats of paint, and it is not very difficult to

convince ourselves that painting is a necessity. However, except in cases affecting public relations, the decision to paint or not to paint must be based upon judgment of the physical rather than the aesthetic values. Paint should be applied to utilitarian buildings for structural reasons only and then only to the parts where it is really necessary to preserve the structural materials.

Parts should be painted when repairs are made and not await the entire repainting of the structure, since the forces of destruction may get started in the interim. It is not uncommon to see a fine maintenance program for painting curtailed over night, which may leave a considerable amount of new material unprotected for an indefinite time.



In the Case of Passenger Stations, Large and Small, The Element of Appearance Must Be Taken Into Consideration

Factors in Recommendations

It is not the purpose of this discussion to detail all of the points which should be examined in forming a maintenance program; neither will all agree as to the relative weight of the several materials that should be used. Actually, varying geographical locations will, in large measure, determine this latter matter, since the most desirable materials to be used differ greatly in various parts of the continent.

Recommendations for the work required must be based upon various factors other than materials and your committee recommends the following order:

(1) Safety—There is no question but that this should be the first consideration.

(2) Protection of structural parts.

(3) Efficiency—This may include better lighting, either by increasing the number of light outlets, painting in light reflective colors, replacing a rough floor with a smooth surface, etc. In many instances savings in operating costs will offset the cost of doing this type of work.

(4) Protection of Contents—This is of importance in freight houses, station buildings, etc., where exposure to the weather may result in damage to the contents and claims from patrons for such damage.

(5) Appearance and Comfort—These are most important in structures where the public is involved, such as station or other semi-public buildings, and to a lesser degree in other types of buildings.

Another consideration is that of preference; that is, should the better and more permanent types of structures be given first consideration, to the possible detriment of the poorer or less permanent types, regardless of the use of the building? It is believed that the affirmative is the answer generally, particularly if there is any chance of replacement of the faulty or obsolete structure within a reasonable length of time or before the value of repairs is used up.

Timing is an important factor in the orderly carrying out of the work and in the laying out of a program, and it should be given consideration. Obviously certain classes of work can best be performed during certain seasons and the program should be laid out with this in mind. Since climatic conditions vary so widely, no set rule will apply universally and the plan must, therefore, be developed through a knowledge of climatic conditions in the areas in which the work is to be performed.

The Record

An orderly record can best be kept on a form that has been well thought out and developed by usage. This will tend to uniformity in character, regardless of who does the actual inspection and the clerical work, and will assure that every important item has been considered. The form should be uniform for the entire railroad in order that records from all divisions, when assembled for the use of general officers and others, will present the information in logical order and not haphazardly, as is the case when notes are jotted down in a note book.

The forms should then be easily subdivided under various heads, such as use, type of construction, extent of requirements, urgency of needed repairs, etc., or reshuffled in accordance with the dictates of the complete program or to develop statistical data in connection with its preparation.

One of the greatest helps for the formulation of the program is the data developed in prior detailed inspections that have been made carefully and unhurriedly at regular intervals and properly recorded. When so recorded, any necessary change in the program, either of extension or reduction, can be decided upon quickly, since the necessary data are at hand in readily available form.

In a majority of the cases, the extent of the work to be done is small, and in such cases the estimate of cost can be developed at the site. However, where heavy repairs are required, estimates should be developed in the office of the bridge and building supervisor.

It not infrequently occurs that economies or improvements can be effected by a considerable change in the plan of a structure when very heavy repairs become necessary. Such problems should be developed in conjunction with the engineering forces and the department affected.

Obsolescence a Factor

Finally, the necessity during the last few years of keeping new construction to an irreducible minimum, has naturally resulted in the retention of many obsolete buildings which normally would have been replaced. This, in turn, would be expected to lead to greater costs of maintenance, but these also have had to be reduced. Therefore, it is absolutely essential that those upon whom rests the responsibility of making the recommendations for maintenance, shall have a sense of values, ingenuity, and the ability to weigh and balance raised to the N-th power, to the end that the buildings of the railroad shall continue to function.

Committee—L. E. Peyser (chairman), asst. arch., S. P., San Francisco, Cal.; J. L. Varker (vice-chairman), supvr. b. & b., D. & H., Carbondale, Pa.; H. L. Barr, div. engr., C. & N. W., Chadron, Neb.; J. E. Bird, insp., N.Y.C., Corning, N.Y.; P. F. Collier, asst. supvr. b. & b., M. P., Monroe, La.; G. S. Crites, div. engr., B. & O., Punxsutawney, Pa.; V. E. Engman, ch. carp., C.M.St.P.&P., Savanna, Ill.; W. J. Hanson, gen. for. b. & b., D. & M., Tawas City, Mich.; W. A. Hutcheson, supvr. b. & b., C. & O., Clifton Forge, Va.; H. G. Johnson, Instman, C.M.St.P.& P., Ottumwa, Ia.; L. P. Kimball, engr. bldgs., B. & O., Baltimore, Md.; W. F. Meyers, supvr. b. & b., C. & N.W., Boone, Ia.; E. Nelson, supvr. b. & b., C. & N. W., Huron, S.D.; J. W. Secker, bldg. insp., C.M.St.P.& P., Chicago; E. E. Tanner, gen'l. supvr. b. & b., N.Y.C., New York;

F. W. White, supvr. b. & b., L. V., Buffalo, N.Y.; L. Yeager, b. & b. insp., N.Y.C., Syracuse, N.Y.

Discussion

C. M. Burpee *(Railway Engineering and Maintenance Cyclopedia)* expressed the view that this report is particularly appropriate at this time because the increased earnings that the railroads are now experiencing are, unquestionably, the forerunner of larger building maintenance programs. Differing with the statement in the report regarding the frequency with which buildings should be inspected, H. B. Christianson (C. M. St. P. & P.) said that all buildings should be inspected annually. On his division the practice is followed of making the regular building inspection in the presence of the division officers of the interested departments. He said that in making such inspections, sight should not be lost of the fact that, because of changed conditions and practices, buildings can frequently be retired, thereby eliminating the cost of maintaining them.

Answering a question from the floor regarding the use of asbestos shingles as siding for exterior walls, Chairman Peyser expressed the opinion that the use of such material for this purpose is good practice and that it makes a good appearance. At some locations, he said, the shingles have a tendency to absorb moisture, but he pointed out that this difficulty can be overcome by coating them with oil. F. R. Spofford (B. & M.), speaking from his experience with asbestos shingles, said they are somewhat subject to breakage, and that, for this reason, consideration must be given to the character of the traffic and other conditions around specific buildings before a decision is made as to whether they are to be used.

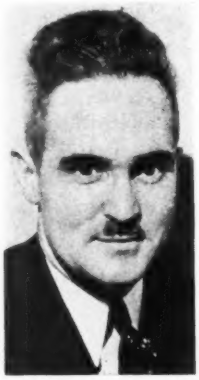
W. A. Hutcheson (C. & O.) reported that in some instances where lime mortar has been replaced with cement-tempered mortar, trouble has been experienced with interior finishes because of water absorption. In reply, Chairman Peyser said that on his road furring is used in the interior of brick buildings to prevent the finish from coming in contact with the wall masonry.

E. C. Neville (C. N. R.) expressed the opinion that, when making inspections of buildings, care should be taken to inspect such parts as foundation sills that are not readily accessible. G. E. Boyd *(Railway Engineering and Maintenance)* said that buildings should be inspected in an unhurried manner, rather than casually and in haste, so that important items of deterioration will not be overlooked.

The Heating of Locomotive Terminal and Shop Buildings

Report of Committee

THIS report deals with the heating of railroad terminals which have locomotive erecting shops, boiler and machine shops, blacksmith and car repair shops, enginehouses, and other terminal and shop buildings served by a central power plant, where boilers in the power plant supply steam for generating electricity, operating air compressors and steam pumps, and furnish high pressure steam to the various shops for power purposes. Under these conditions, it is obvious that the central power plant should also act as a central heating plant, for practically all of the exhaust steam from the generating equipment, air compressors, and steam pumps can be used for heating purposes.



I. A. Moore
Chairman

Design

Each part of the entire heating system, from the central plant to the smallest local unit, must be designed for its purpose, and be properly equipped with valves, traps, vents, expansion joints, and other specialties, to secure a proper and balanced installation. In new buildings, the design and construction should aim at the minimum heat loss consistent with reasonable cost, comparing the overall cost of insulation with the savings in fuel under average conditions. Only a fair consideration of all factors, including both the physical condition of the building and the type of heating installation to be used, can determine an economical and properly designed heating system.

In modernizing old installations, consideration should first be given to the building, to eliminate all heat losses possible, and then to a study of the existing heating system. It may require a complete re-design, or may be corrected in part only, such as relocating the actual heating elements, changing size, type, or capacity, etc. Special care should be given to main supply and return lines, and all sags, bends, or air-blocks removed; also, valves and traps may be faulty or may need renewal. The question of the extent of the modernization to be done depends on the probable remaining life and the value and importance of the building to the railroad.

Piping

Pipe installations may be of genuine wrought iron or black steel pipe, depending upon the condition existing at the location under consideration. Wrought iron pipe is preferable where gases and moisture are present to cause serious maintenance problems due to corrosion of the pipe. This difficulty is encountered in enginehouses. Steel pipe is satisfactory for many heating installations, especially in buildings where very little corrosive action from gasses or moisture is expected.

Welded connections should be used for all pipe lines where pipe two inch and larger is being installed. Welded connections have many advantages over flanged or screw-type connections, some of which are (a) lower cost for labor and material, particularly in the larger sizes; (b) lower maintenance cost; (c) much neater finished job; and (d) additional connections can be installed in existing lines with little or no disturbance to the line.

It is considered good practice to construct a pipe tunnel from the central power plant to the various build-

ings to be heated. This tunnel should be constructed of concrete and of sufficient size to permit ample working space for maintaining the various pipe lines. A reasonable size is six feet high by four or five feet wide. Liberal sized manholes should be provided at approximately 200 or 300-ft. intervals for access to the tunnel and particularly for ventilation for workmen when making repairs to pipe lines therein. It is essential that proper drainage be provided for these pipe tunnels.

Such tunnels may not only house steam pipes, but air, hot and cold water, gas, oil, and other supply lines as well. These pipe lines should be arranged in such a manner that they can be inspected and repaired readily. Although the heat loss in steam piping in such a tunnel is of little consequence, it is advisable that these pipe lines be insulated.

Overhead and Inside Piping

An overhead pipe line for the transmition of steam can be constructed at a much lower cost than a tunnel installation; however, better insulation must be provided, together with a weather-proof jacket over the insulation. Furthermore, the maintenance cost of an overhead pipe line is much greater than for similar pipe lines in tunnels.

There is also the necessity for providing pipe lines for returning the condensation to the boiler, and this is usually accomplished by providing an underground return line, laid in an insulated conduit. Of course, the condensate can always be wasted in an adjacent sewer, but this is not good practice. An overhead steam pipe line is justified where no other piping service is required—that is, for heating purposes only.

Steam heating pipe lines should be taken out of the pipe tunnel adjacent to buildings and continued through the buildings in exposed locations. They may be placed overhead, or around the building walls. In some cases they are insulated; in other cases not. When not insulated, the assumption is that any loss tends to heat the building being served. If the supply of exhaust steam should be insufficient for the buildings so served, high pressure steam may be admitted to the heating main through a pressure-reducing valve at the building site—assuming that the high pressure steam lines are also carried in the pipe tunnel.

Before the advent of cast iron radiation it was the practice to install pipe coil radiation. This type of radiation was simple to install and maintain, with no worry about high or low pressure steam, and usually high pressure steam was furnished. In many instances, it seems as though radiation was installed without regard to the amount necessary to heat the building properly. It was the accepted practice at that time to place heating coils under all windows and adjacent to, or under, skylights.

Unit Heaters of Various Types Have Been Used Effectively in Shops and Other Terminal Buildings

In the older types of engine houses, heating coils were placed in the engine pits. In this location, the heat from the coils will remove the ice and snow from the underside of locomotives. However, heating coils in engine pits constitute a hazard to men working in the pits and around the engines, while the water from melting snow and ice, dripping on the coils in the pits, adds to the vapor and fog already in the house.

Blast Heating

Hot air, or blast, heating is a vast improvement over the pipe coil, or radiation system of heating, especially in engine houses. The blast heating system consists of banks of cast iron radiators or pipe coils; a motor- or steam-driven ventilating fan; and a duct system for carrying the heated air to the various parts of the building to be heated.

This equipment is usually housed in an annex to the building to be heated. The heating coils are placed adjacent to an outside opening provided with louvres to keep out rain or snow; the outside air is drawn through the heated coils and forced through the duct system by the ventilating fan.

The duct system may be overhead or underground, and decreases in size from the heater room to the extremities of the building. The underground duct system, usually constructed of concrete with laterals of sewer tiles, is rather costly but requires little, if any, maintenance. The overhead duct system is usually constructed of metal pipe and costs less than the underground system, but the maintenance is high; often it is difficult to provide a suitable location for such ducts. An overhead duct system in an enginehouse has a very short life on account of the corrosive gases present.

Some installations in enginehouses are so constructed that the air is recirculated. This reduces the amount of steam supplied to the heater coils very materially. It is not the best practice but produces very good results. The heating of enginehouses with hot air is very desirable, as considerable moisture in the air is absorbed by the circulating hot air.

Unit Heaters

The advent of unit heaters marked an advance in methods of heating, not only providing better distribution of heat, but also effecting a decided reduction in the cost of heating.

There are three main types of unit heaters—projection, propeller and blower. In the projection type, the motor shaft is set in a vertical position; the fan and heating elements are located directly below the motor, and the heated air is directed downward, covering a circular area. In the propeller type, the motor shaft is set in a horizontal position with fan and heating elements in a vertical position; the air is directed downward at an angle towards the floor where it is deflected in all directions. The blower type is a much larger heater, with the motor set in a horizontal position, driving a shaft to which rotating fans are attached, with the heating elements in the fan housing. Various openings are provided in the fan housing where ducts can be attached. Such heaters can be located on the floor, or suspended from overhead.

Each type of unit heater has its particular use. However, the usual type is the propeller unit heater. It is the accepted practice to suspend such heaters from the roof supports, from the columns, or somewhere near

the outside walls, depending upon the type of structure to be heated and the best location of the heaters for supplying heat where it is most needed.

Most heaters are supplied with copper cores, which compose the heating element. There are heaters on the market which have cast iron cores, and others with steel pipe cores to which fins are attached. Heaters can be furnished for either high or low pressure steam.

Unit heater installations require much less piping, fittings and valves than a comparable amount of cast iron or pipe coil radiators, based on the heat output of each facility. They occupy much less space, and in a suspended position require no floor space.

It is preferable, in most instances, to provide heaters with low outlet temperatures and large capacities, the reason being that less velocity is required to force the heated air to the breathing zone, and lower temperature air will not rise as rapidly as that of higher temperature.

Thermostatic Controls

Unit heaters can be fitted with thermostatic controls, which provide means for effecting economies in steam consumption. However, it is the practice to provide push-button control for each heater. With such controls, only those units that are required need be placed in operation. Unit heaters may be operated in the summer months for circulating air.

Heaters with cast iron cores should be used in enginehouse installations because of the corrosive action on heaters with copper cores. They should be placed about 12 to 14 ft. above the floor line and a short distance from the rear wall, between alternate stalls. The heated air is directed downward and towards the entrance doors. Some railroads place heaters in engine pits to expedite the removal of ice and snow from the underframes of locomotives.

In other shop buildings, heaters should also be placed 12 to 14 ft. above the floor line. If possible, the locations should be such as to provide a circular motion for all of the air in the building, and yet be directed primarily towards the windows and door openings. It is essential that proper pipe sizes be provided, and that steam traps be of ample size.

Heat Losses

A careful study of the heat losses in the buildings under consideration will usually disclose many opportunities for eliminating, or reducing, a large proportion of these losses. In general, ordinary shop buildings present little opportunity for thermal insulation, except the roof areas.

All buildings can be made reasonably tight by continuous putty and glazing repairs, caulking around doors and windows, and providing storm sash where practicable. Sash-operating devices for steel sash windows should be inspected each season and repairs and adjustments made where found necessary. In some instances, windows may be removed and the openings thus formed be filled with glass blocks, thus eliminating maintenance and reducing the heat loss to some extent.

Careful study should be given to ventilation in certain buildings such as blacksmith shops and paint shops, where building codes require a definite number of air changes per hour to carry off obnoxious gases. Heat losses are severe in such buildings, especially where spray painting is being done. Close cooperation with the foreman in charge should be secured to see that exhaust fans are operated only as needed.

Conclusions

Heating installations of any magnitude should be developed from studies made by competent engineers. Heat losses in buildings, the amount and proper location of heating units, proper pipe sizes, expansion joints, are all matters of design.

The main supply lines should be thoroughly insulated, and where exposed to the action of the weather, waterproof covering must be provided to protect the insulation. Welded joints are preferable to screwed or flanged connections for pipe sizes of two-inch diameter and over.

In the replacement of pipe coil radiation, careful consideration should be given to the use of unit heaters from the standpoints of low first cost and efficiency of operation.

The primary purpose of a heating system is to maintain temperatures that will permit the men to work in comfort; failure in this causes loss of time and efficiency.

Committee—I. A. Moore (chairman), supvr. b. & b., C. & E. I., Danville, Ill.; L. C. Winkelhaus (vice-chairman), arch. engr., C. & N. W., Chicago; U. S. Attix, gen'l fire prev. engr., S. P., San Francisco, Cal.; J. K. Bonner, supvr. b. & b., N. Y. C., Buffalo, N. Y.; G. E. Boyd, associate editor, *Railway Engineering and Maintenance*, Chicago; E. H. Brown, bldg. supt., N. P., St. Paul, Minn.; H. M. Ferry, mast. carp., Erie, Youngstown, Ohio; M. A. Higgins, arch. dftsman., C. & N. W., Chicago; Geo. Hout, bridge insp., N. Y. C., Albany, N. Y.; J. J. LaBat, asst. supvr. b. & b. M. P., Poplar Bluff, Mo.; T. D. McMahon, arch., G. N., St. Paul, Minn.; N. F. Podas, ch. engr., Minn. Trans. Ry., St. Paul, Minn.; J. S. Vreeland, associate editor, *Railway Engineering and Maintenance*, Chicago; J. A. Wilson, asst. engr., C. & N. W., Sioux City, Iowa.

Discussion

The discussion of the report was devoted principally to the consideration of gas as a fuel for heating and to the advantages of unit heaters. L. E. Peyser (S. P.) stated that in the territory where he is located (California), gas is cheap and readily available and that, as a result, gas-burning unit heaters are used extensively for heating railroad stations and shop buildings. He said that it has been his experience that such heaters are more efficient than boiler installations and that their first cost is less. In answer to a question raised by F. H. Soothill (I. C.) Mr. Peyser stated that no trouble had been experienced in the use of gas-burning unit heaters through the exhaustion of the oxygen in the atmosphere of heated structures.

Referring to the statement in the report regarding the cost of unit heaters, A. Chinn (Alton) raised the question as to whether the savings effected by such heaters are sufficient to justify the removal of less efficient heating installations and their replacement with unit heaters. The consensus was that the answer to this question would depend largely upon conditions at a particular location.

Discussing the advantages of unit heaters, Mr. Peyser pointed out that his company uses two-directional heaters which permit the heat to be directed as desired to any particular location. As a result of his experience with unit heaters, W. A. Sweet (A. T. & S. F.) said that where such heaters are installed in engine houses they should be so placed as to blow warm air toward the windows. M. A. Higgins (C. & N. W.) described a case in which pipe coil heaters installed near the roof of a shop failed to heat the building properly. The solution of this problem, he said, was to remove these heaters and replace them with an installation of unit heaters more suitably placed.

T. D. McMahon (G. N.), explaining that his railroad is located in a region where climatic conditions are severe, stated that extensive use is being made of unit heaters. He said that the experience of his company has been that the copper tubes in such heaters rust out rapidly, but that this problem has been solved satisfactorily by the use of cast iron cores with aluminum fins. It was his opinion that the first cost and the maintenance charges for unit heaters are considerably less than for installations involving boiler plants.

The Detection and Elimination of Termites in Railway Structures

Report of Committee

THE subject assigned to the committee is an interesting one and one which becomes more important as evidences of the activities of the termites, or "white ants" as they are commonly called, are found over ever-increasing areas.

Perhaps before we go into this subject further some reference should be made to the role which the termite plays in nature and the following is quoted from one of Dr. Herman Von Schrenk's writings. "We are frequently asked by people why there should be such a pest. It is almost a truism that few things occur or act in our world which do not have some significance, or which do not play some part in the general economy of nature. Unfortunately, in many cases, we are unable to trace or understand what the particular significance may be. In the case of termites, however, we have a fairly good appreciation of the role which these insects have played for many millions of years. Briefly stated, they are one of the leading scavengers of the world. Whenever any organic matter, particularly the trunks of trees, branches, leaves and other vegetable parts die, the termites begin their activities and in very short order they more or less reduce the dead material to what may be called a soil condition. They do this not only with wood but with all sorts of other organic material. They work hand in hand with wood-destroying fungi, with the numerous bacteria and other scavenger insects, worms, etc. Picture to yourself what the surface of this earth would look like if all these scavenging agencies were eliminated for a brief time. I think you may be surprised at the thought that within an incredibly short period, say 10 years, if not less, the surface of the earth would be so encumbered with dead matter that there would be no opportunity for living organisms to find a foothold. By eating and converting dead wood, the termites therefore have played and are still playing a very particular role, making it possible for succeeding generations of other living organisms to develop and prosper.

"Assuredly, we have very little to criticise if they follow their age long instincts and destroy wood and other organic matter irrespective of where

T. H. Strate
Chairman

they find it. It is just too bad for us that much of this dead wood is in houses, buildings and other structures where their presence is undesirable, but we can hardly blame them for failing to recognize this. To those who are philosophically inclined, I strongly recommend the reading of that delightful book which appeared a few years ago, by the great philosopher, Maeterlinck, entitled, "The Life of the White Ant." He not only dwells extensively on the picture which I have just touched upon, but speculates as to the possible correlation which may be drawn between the amazing development of these remarkable insects and the human family."

Termites are more or less social workers with other ants and have a well organized community composed of workers, soldiers and reproducers (the "king" and "queen"). Only the latter two have reproductive powers but they have a long span of life, often as long as 15 or 20 years. At one stage of the life of the king and queen, they have sight and wings for a short time, which enables them to find a new location and start a new colony. The king and queen take care of the young until the family has increased enough to feed them, after which they remain in the nest and the queen gradually loses the power of locomotion and becomes practically an egg-laying machine. The number of eggs produced is enormous and most of the ants become sightless grayish-yellow workers (which are erroneously called white ants), while others become soldiers who protect the workers.

Certain conditions are necessary for the existence of termites, namely dampness and darkness, and the fact that they do work under cover makes their detection all the more difficult and often allows them to do considerable damage before being detected. As stated above, these insects avoid light and burrow from their nest to nearby buried wood, and it makes no difference to them whether this wood is a log in the forest or a vital portion of a building. As long as they can have access to the wood their activities continue and after a while the interior of the wood is practically removed so that what appeared to be a sound piece of timber is a mere shell. This may create a very hazardous condition.

Termites occur in practically every state in the United States, and outside of the United States all over the world in tropical and temperate lands. A map has been prepared by the United States Department of Agriculture, which shows the widespread area of their distribution in the United States.

Any kind of wooden structure may be affected, although buildings well constructed and maintained are much less liable to attack than those poorly built. Age makes no difference to the termites. They may be found in both old and new construction.

Nature of Attack

The nature of attack in the United States is generally through the ground, which means foundation walls, posts and parts that are in contact with the soil. This is the nature of attack of the common subterranean termite. On certain parts of the Pacific coast there is an aerial form of termite, which attacks buildings from the air.

Termite nests or colonies are rarely found because they are always hidden underground. The appearance of termites in a building does not mean that the so-called "nest" is in the house, or anywhere near the house. It may be a long way off. The workers are great travelers, building tunnels all through the ground in their search for food.

Many species of termites actually grow their own food. Upon a specially prepared base, they cultivate various fungi, or mushrooms.

The subterranean termites get into a building only from the soil. In other words, there must be some approach from below the ground into the building. They cannot start their operations by coming into a building through doors or windows. If fire wood is brought into a cellar, even if it contains countless workers, they cannot start operations in the woodwork of the building itself. One of the most likely points of entrance is through foundation walls, when, after a period of time, cracks form in the mortar, thereby forming ready points of entrance. This is particularly true where lime mortar has been used as the termites can dissolve lime mortar. The second point of attack is in and around window casings, placed in depressed points like cellar windows, coal windows, cellar stairways, etc. Posts in the cellar used for walls of storage bins and door frames similarly situated in the cellar are frequent points of attack. Water and other types of pipes, coming through concrete floors or walls frequently offer a point of entrance. In houses with no cellars, the method of entrance may consist in building shelter tubes vertically from the ground.

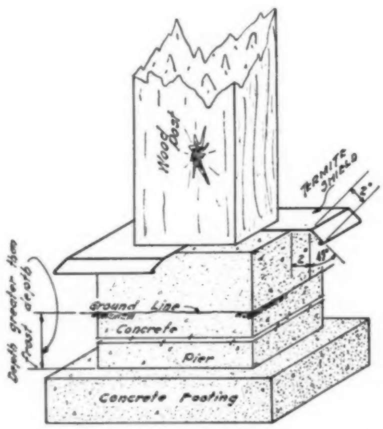
In buildings with concrete walls, or of slab construction, points of entrance have been found through air pockets in improperly tamped concrete, through shrinkage cracks, or between slabs separating sufficiently to form cracks.

Evidence of Presence and How to Detect

The first and most positive indication of the presence of termites in a building is the observation of swarms within the building. This always means that the workers are in the woodwork of the building. If there is no such observation, the next thing to do is to examine the woodwork on the lowest floor, preferably from the cellar. If the ceiling of the cellar consists of lath and plaster, a sufficiently large strip of the lath should be taken off and an examination made of the joists, studs and top of the wall. It is important to look for the shelter tubes or carton-like building material which will usually be in evidence in case the insects are at work.

The dry-wood termites fly and attack timber in dwellings, dead trees, etc., and can exist in wood containing less than 12 to 15 per cent of moisture. They do not follow the grain of the wood continuously, but cut across and excavate through it longitudinal chambers of limited length connected by tunnels. Their pellets of partly digested excreted wood sometimes completely fill or block up the burrows and sometimes the pellets are expelled as dry droppings from the infested wood and serve as a warning of infestation. The subterranean termite, as mentioned before, burrows through the earth and attacks wood indirectly from the earth, with which they must maintain contact to obtain the moisture so necessary to their life. They usually follow the grain in eating wood and honeycomb it.

Termites appear to be sensitive to vibrations; they are seldom found in



Sketch of Termite Shield Used Between Wood Post and Concrete Base

railroad ties over which there is frequent heavy traffic, or in the wood work of mill or factory buildings in a vicinity where heavy machinery in motion would cause vibration. The possible reasons are that vibration would not only interfere with their method of communications, but also, if heavy enough, would break off shelter tubes. If the whole or a part of a structure containing untreated wood shows signs of failure which cannot be attributed to natural causes such as depreciation, load, etc., it should be examined for termites to determine if the failure was due to their presence.

Termites carry on their destructive work hidden from sight, seldom revealing their presence. However, the swarming, usually in the spring and fall of the year, is certain evidence of their being in the vicinity. The presence of shelter tubes is another evidence of presence. Termite damage is often mistaken for rot as it is difficult to distinguish between the two. Actually, rotting follows termite attack because they carry on their bodies the fungus spores which cause rot. Therefore, if one should discover rotten timber, this might indicate a previous termite attack. They may be also detected by the fecal pellets dropped from the workings of dry-wood termites.

Solid wood struck by a hammer rings clear, while timber eaten out by termites will give a dull thud when struck. Weakened timber is also detected by a sharpened pick or bar. Clean cut holes in books, papers, clothing, etc., are good indications of the presence of termites.

Nature and Extent of Damage

The extent of damage is difficult to define. If let alone they will destroy practically all wood, particularly the spring wood of coniferous woods.

It is estimated that termites do from \$40,000,000 to \$50,000,000 worth of damage annually in this country to wood in buildings, to fences, to poles and books, clothing, leather goods, etc. This is a large item, and there is an idea that a very dangerous condition exists. This has been brought to public attention by both the technical and popular press greatly in recent years, and as in many other lines, has produced a genuine fear in places as to the use of wood in the building of houses and other structures. Little anxiety need be felt provided proper precautions are taken in the use of wood and methods of construction are followed which will prevent access of the insects into the building. In short, all termite damage to man-made structures may be laid primarily to improper construction.

Methods of Elimination

The problem of eliminating the dry-wood or non-subterranean type of termite is simpler than in the case of the subterranean type. Both gas and heat to 130 deg. and over are effective against them.

The subterranean type is much more destructive. The workers and soldiers can be destroyed by removing their access to a supply of moisture or water. No attention need be paid to those left in the building or structure. They will promptly dry up and die.

Removal of the shelter tubes will accomplish the same results unless they have runways within the walls and can reach moisture from such sources as a leaking water pipe, condensation, etc.

In reconstruction work, care should be taken to correct the errors of original construction, the first step being to inspect all wood below the

line of the first floor. All structural members should be replaced if weakened by the insects—using pressure-treated woods. All wood removed should be burned. If foundation walls are cracked and porous, replace the top with good cement masonry and at the same time install metal termite shields. Where post and pier foundations are found, cap with termite shields.

Generally speaking, the solution lies in the closing of the point of entrance, which necessitates careful study of each particular structure, floors, partitions, doors and windows, each requiring special attention. Elimination of contact between earth and wood, removal of all debris, roots, etc., proper ventilation under floors and in basementless spaces—and last but not least—proper drainage of wet or damp ground, will go a long way towards curbing the termite infestation. Where it is necessary to have wood in contact with earth, see that it is pressure treated.

Termite-Proof Construction and Recommendations

The sum and substance of any recommendations for the construction of buildings to withstand termites is, of course, answered by a simple statement, "build to prevent the entry of the insects." The design should be such that the insects cannot possibly get at the wood work.

A study of suggestions and recommendations in various publications and reports of the Government, the American Wood Preservers' Association, the National Lumber Manufacturers' Association and other organizations and commercial concerns, to all of whom we are indebted for our information, shows a very marked similarity of instructions.

The 1934 Proceedings of the American Wood Preservers' Association contains a discussion on termites by Dr. Von Schrenk, who makes the following points in connection with the subject of design, which appear to be the basis of today's practices.

(1) Use only cement mortar in the construction of foundation walls.

(2) Have the foundation walls sufficiently high above the ground so that wood-work of any sort will be removed from the surface of the ground.

(3) Provide all foundation walls with approved copper or other long-lived metal shields. The strips of the shields should be soldered where the ends overlap. Furthermore, the overhang of these shields should be at least three inches beyond the wall and the 45-deg. bend should be at least two inches wide. The shields should extend on both sides of the foundation wall, that is, inside and outside of the building.

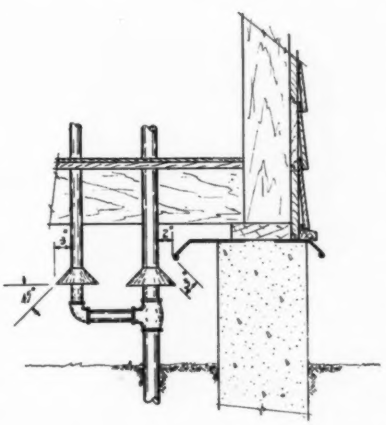
(4) Irrespective of whether shields are used, the top surface of the foundation wall should always consist of a coating of rich cement mortar carefully trowelled. .

(5) All openings for window casings, cellar doors or other openings through foundation walls should be covered on all surfaces with rich cement mortar so that there may be no chance for termites to get from the foundation into the wood casing.

(6) Concrete slabs should provide a triangular depression where the slab joins the vertical wall or where adjacent slabs abut against each other. After the concrete has hardened, these joints should be filled with a fairly plastic coal tar pitch. Asphaltic compounds are of no use whatever.

(7) When there is an unexcavated section under the house, wherever possible lay a thin concrete floor on the soil so as to prevent the entrance by means of vertical tubes to the overhead wood-work. Use pitch seals between slabs and at the walls.

(8) In cellars, lay the concrete first, and put any boards or posts on top of the concrete.



Dimensions shown are for "MINIMUM" conditions.

Sketch of Metal Termite Shields Used Around Pipes Entering a Building and at the Top of Foundation Walls

(9) Have all pipes of whatever sort provided with copper shields near the point of entrance into the building.

(10) Where wood has to come in contact with the ground or where it is located very close to the ground as in porches, use only treated lumber, preferably treated according to the specification of the American Wood Preservers' Association, with coal tar creosote. Termites will not attack creosoted wood where the treatment has been efficiently conducted.

(11) When possible, cover the outside of the foundation wall with a good quality of coal tar pitch.

Use of Chemicals

The use of chemicals to sterilize or poison the ground under buildings and around outside of foundations is a later development, using a copper sulphate solution, with four pounds of crystals to five gallons of water in the first case, and full strength Orthodichlorbenzene in the second case. In the case of the latter, the chemical should be applied in the bottom of a trench 30 in. deep and at least 12 in. wide around the foundation walls. The soil should be saturated at the rate of one gallon per ten linear feet, the soil then replaced to within three inches of the surface and the treatment repeated. This treatment is not permanent, however. A petroleum-creosote solution may also be of benefit if it is not desired to use the chemical mentioned above, which has a number of objectionable features in handling.

The termite is not a new insect in the world but is probably one of the oldest forms of life on the globe. The damage caused by it is no doubt exaggerated. Remember that termites must have their home in the ground, where they find an unfailing source of moisture. Destroy the ground contact and you destroy the termite. It cannot stand exposure. Termites are not brought into a building in either new or old lumber, nor is lumber used in buildings properly constructed in danger of being damaged by termites.

Committee—T. H. Strate, (chairman) div. engr., C. M. St. P. & P., Chicago; F. H. Masters, (vice-chairman) ch. engr., E. J. & E., Joliet, Ill.; E. L. Rankin, (vice-chairman) arch., G. C. & S. F., Galveston, Tex.; Maxfield Bear, est., C. & N. W., Chicago; H. I. Benjamin, chm. sys. ins. com., S. P., San Francisco, Cal.; C. W. Boyce, supvr. b. & b., I. C., Vicksburg, Miss.; H. B. Christianson, div. engr., C. M. St. P. & P., Savanna, Ill.; T. B. Collidge, asst. supvr. b. & b., N. Y. C., Syracuse, N. Y.; J. E. Heck, bridge insp., C. & O., Peru, Ind.; H. Heiszenbuttel, supvr. b. & b., C. & N. W., Norfolk, Neb.; N. D. Howard, managing editor, *Railway Engineering and Maintenance*, Chicago; W. W. Kerr, Jr., instman, C. & N. W., Chicago; P. L. Koehler, div. engr., C. & O., Ashland, Ky.; C. A. Landstrom, mast. carp., C. B. & Q., Burlington, Ia.; B. W. Logan, gen'l. for. b. & b., C. R. I. & P., Little Rock, Ark.; C. A. J. Richards, mast. carp., Penna., Chicago; F. H. Soothill, ch. est., I. C., Chicago; L. R. Thompson, supvr. b. & b., M. & St. L., Oskaloosa,

Ia.; K. J. Weir, water insp., C. M. St. P. & P., Chicago; B. M. Whitehouse, insp., C. & N. W., Chicago.

Discussion

The discussion centered largely around the treatment of the soil about foundations to keep termites out of buildings. Several took exception to the recommendation in the report relative to the use of Orthodichlorbenzene, W. J. Burton (M. P.) pointing out that it is dangerous to use this compound full strength, with R. E. Meyers (International Creosoting & Construction Company) agreeing and pointing out that the poison gases given off from this material are liable to be injurious to health. W. P. Arnold (The Wood Preserving Corporation) questioned the value of copper sulphate as a termite deterrent and recommended as effective a heavy application of creosote-petroleum mixture to the soil near the base of the foundation and again near the surface of the ground. L. E. Peyser (S. P.) spoke of the spraying or painting of foundation walls with a cut-back creosote to discourage termite infestation.

Speaking again, Mr. Meyers cautioned that the termite menace is spreading throughout the country, damage having been observed in every state, and said that while he endorsed the recommendations of the committee concerning keeping termites out of existing buildings, he felt that the only sure way to prevent the destruction of timber in buildings by termites is to use properly treated timber in original construction.

Commenting upon several phases of the report, F. H. Soothill (I. C.) first cautioned against the use of creosoted timber in buildings where it might be objectionable to occupants or might contaminate products held in storage, citing a case where lack of consideration in this regard had caused damage to about 40,000 lb. of sugar. He then reminded those present that laws in several states govern the compounds that can be used to prevent destruction by termites, and said that in Louisiana the application of many compounds must be made by a licensed applicator.

H. M. Church (C. & O.) said that, in the interest of protecting the lumber and timber in buildings against decay and attack by termites, his road has been using salt-treated timber extensively for about five years in building repairs and in new construction, especially where the odor of creosote might be damaging. No one knew of any railroad employing the X-ray to locate termite infestation in buildings, but it was suggested by R. R. Clegg (American Lumber & Treating Company) that the Detroit Edison Company, Chicago, had used this method at least to some extent in examining the condition of poles.

Mechanization of Bridge and Building Forces

Report of Committee

MECHANIZATION is a broad term used to describe the use of power-operated tools and equipment to perform classes of work that formerly were done manually. In bridge and building work, such operations as the mixing of concrete and the driving of rivets were mechanized many years ago, and it is quite possible that the use of power tools in bridge work antedated their introduction in the track department. During the last decade, however, the trend toward mechanization of bridge and building forces has been given a decided impetus by the development of small portable power tools, such as saws, drills, and wrenches, either pneumatic, electric or mechanical in operation, which are operated from power plants that can be moved about readily.

M. H. Dick
Chairman

Types of Equipment

For the purposes of this report it may be desirable to review briefly the types of power tools and equipment that are now available for application to bridge and building work. Among the portable power tools of more recent introduction are timber saws of both the two-man chain type and the one-man safety type; wood augers and drilling tools for various purposes; nut runners and lag screw drivers; and impact wrenches. For the operation of these tools one may take his choice in most cases of either pneumatic, electrical, or flexible-shaft drives, the power in the latter case being furnished by a gasoline engine. In fact, the increasing popularity of power tools for use in the field is due in no small part to the development of small portable power plants of various types.

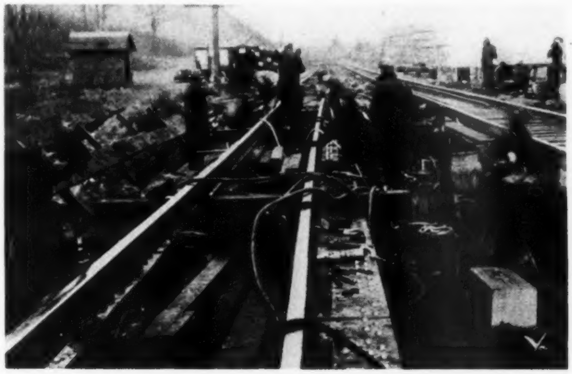
In addition to the tools named above, other power equipment that is in common use by bridge and building forces includes concrete mixers, jack hammers, concrete breakers, concrete vibrators, riveting hammers and holders-on, chipping hammers and scalers, rotary wire brushes, welding and cutting outfits, portable grinders, power pumps, sand blast outfits, paint spray guns, motor trucks, track motor cars, pile drivers, and cranes, hoists and derricks. Some of these tools have been in common use on the railroads for many years, while others are of more recent introduction.

Thus, it is apparent that there are power tools and equipment available for performing practically all the more common classes of work that are encountered by bridge and building forces. In recent years the use of power equipment has been greatly extended, not only because of the introduction of new types but because the rising trend of wages and the need for stretching the maintenance dollar as far as possible have made even more imperative the necessity for reducing the unit costs of performing all types of railway bridge and building work.

Obviously, the primary objective in the use of power equipment is to reduce costs, but mechanization also has other important advantages over hand methods. For instance it is generally agreed that the quality of the work performed by mechanical means is better and more uniform than that done by hand. Moreover,

with the aid of mechanized equipment, renewal or repair projects can be completed in a fraction of the time that would otherwise be required, thereby reducing the duration of slow orders and resulting in less interference with traffic. Furthermore, there is reason to believe that the use of power equipment results in a reduction in the number of personal injuries.

The trend toward the more extensive use of power equipment has naturally brought to the fore many questions relating to the efficient and economical use of such equipment. Tests conducted with various power tools have repeatedly demonstrated their economy as compared with hand methods. However, in order to realize the maximum return on the investment in power tools it is necessary that, in their acquisition and use, consideration be given to the broad question as to how they are to be incorporated into the bridge and building department as a whole.



The Committee Found That the Mechanization of Bridge and Building Forces in Accordance With Sound Practices Offers Numerous Advantages

In any study of this subject we are immediately confronted with such questions as the following: (1) To what extent are we justified in equipping individual gangs with mechanized equipment (2) In what degree should machines be held at central locations and assigned to individual gangs as needed? (3) What changes in the organization of individual gangs and of bridge and building departments as a whole should be made to assure that advantage will be taken of the maximum possibilities offered by mechanized equipment?

Obviously the answers to these and other questions attending the use of power tools will depend largely on conditions on the individual roads. It was for the purpose of finding out what the maintenance officers of various roads are thinking and doing about the matter that the committee circulated a questionnaire among 53 roads, of which 42 submitted replies, although five of these did not give detailed answers.

Practically all of the roads that submitted detailed answers stated that the trend in recent years had been in the direction of greater mechanization of their bridge and building forces. However, 25 of them still feel that their bridge and building forces are not adequately mechanized, although all of these companies expect that, as conditions warrant, the process of mechanization will be continued until their forces have been adequately equipped. Twelve roads said that their bridge and building forces had all the power tools and equipment that they need at the present time.

Mechanization Not Complete

Enlightening information regarding the direction that mechanization programs are taking was given in answers to a question asking the roads to name the types of equipment that have recently been in the greatest demand. These answers indicated that by far the greatest demand has been for small portable tools, such as saws, drills and augers, and nut runners, with the necessary power plants. However, they also indicated that heavy purchases have been made of a wide range of other items, including paint spray outfits, power pumps, demolition tools, concrete mixers, welding and cutting outfits, sand blast and other cleaning equipment, motor trucks, steam pile hammers, and cranes, hoists and derricks of various types and sizes.

In spite of the fact that the roads have recently acquired large numbers of the types of equipment named in the foregoing, answers to another question indicated that there is still a heavy demand for equipment in the same categories. The answers to this latter question also listed as being in demand today a number of machines that are not now in common use by bridge and building forces. One of these is a small truck crane for handling materials; another is a self-contained gasoline-operated concrete buster; a third is a power-driven pipe-threading machine.

Answers to the questionnaire indicate that there is wide variation in the extent to which the different railroads have mechanized their bridge and building forces and in their practices regarding the assignment of power tools. As to the extent of mechanization, there are on one hand railroads that are only now beginning to equip their forces with the newer types of power tools, while on the other hand there are roads that have completely equipped their forces with the most modern machines. Between the two extremes there is a wide range of practices.

In the method of assignment, at one extreme of practice are those roads that centralize all power tools, assigning them to individual gangs only as needed, while at the other extreme are those companies that have found it advisable to furnish each gang with complete sets of certain power tools, centralizing only the larger and more expensive machines, such as cranes and pile drivers, or those used only infrequently.

What is being done in the way of mechanization can best be illustrated by the use of specific examples showing how the more common types of gangs have been mechanized on representative roads. In this connection it should be noted that, because of fundamental differences in local conditions and in organizations as between different railroads, the committee feels that it would not be possible, or even advisable, to submit recommendations regarding the mechanization of individual gangs. But it is felt that representative examples showing practices on progressive railroads will serve to indicate the extent to which such roads consider it profitable to mechanize their bridge and building forces.

Types of Gangs

The manner in which the bridge and building forces are organized varies widely on different roads but on the majority of the lines it may be said that there are five different types of bridge and building crews, namely: (1) Division bridge and building gangs, which make routine repairs to buildings, trestles, bridge decks, etc.; (2) steel bridge repair and maintenance crews; (3) masonry repair gangs; (4) paint gangs; and (5) water service repair gangs. Of these, the steel, masonry and paint gangs may be organized on a system, regional or divisional basis, but in either case the problem of mechani-

zation is substantially the same. Water service repair crews are usually division gangs. Some railroads have "composite" or combination gangs which perform the work of several or even all of the types of crews named above.

An example of the manner in which division bridge and building gangs are being mechanized is afforded by the practice of a southern line. On this road, which, incidentally, is among those that feel that their forces are adequately mechanized, the power tools and machines that are furnished as standard equipment to typical division gangs consist generally of the following:

Motor cars and trailers as necessary
Air compressors
Concrete mixers with water heaters
Electric or pneumatic wrenches
Electric or pneumatic wood boring machines
Rotary grinders with wire brushes (pneumatic)
Scaling tools (pneumatic)
Riveting hammers (pneumatic)
Rivet busters (pneumatic)
Small portable paint spray outfits

In addition to these machines, centrifugal water pumps, electric safety saws and motor-car paint spray outfits, along with such units as cranes and pile drivers, are held at central locations and assigned to individual gangs as needed. Moreover, at each terminal it is customary for this road to furnish the supervisor of bridges and buildings a 1½-ton auto truck.

By reason of the nature of the work that they perform, steel bridge gangs lend themselves readily to mechanization. Moreover, the majority of the roads have one or more system or regional gangs for carrying out maintenance and repair work on steel bridges and the specialized nature of these gangs is in itself an argument for a high degree of mechanization. Also, the power tools and equipment available for use by such gangs have not only been improved in efficiency and effectiveness, but additional units have been introduced in recent years.

Representative of the highly-mechanized system steel bridge repair gangs of today are those on an eastern line. On this road each steel gang is regularly supplied with the following types of equipment:

Motor cars
Compressors (220 cu. ft.)
Rivet busters
Rivet guns (retainer fitted)
Power wrenches
Circular hand-held power saws
Variable-size chipping guns (retainer fitted)
Oxy-acetylene cutting equipment
Variable speed air-motors for grinders, brushes, drills and reamers
Wood borers and lag screw wrenches operated by reversible motors
Pneumatic bench grinders for dressing tools
Air hoists
Concrete busters
Stone hammer drills
Welding outfits
2½-ton auto trucks
Hand-operated ¼-ton, 1-ton and 2-ton derricks

Equipment that is used infrequently by the steel gangs on this road, such as locomotive bridge cranes and wrecking derricks, is assigned when needed. Occasionally the duties of the steel gangs include the complete painting of major steel structures in connection with repair programs. In such instances a paint crew is incorporated in the gang and paint spray equipment is provided.

Paint Gangs

On the great majority of the roads, paint gangs are organized on a divisional basis, and it is apparent from the answers to the questionnaire that the practice of equipping such gangs with paint spray outfits is almost universal. On a southern line, on which the practice seems to be representative of most companies, division paint gangs are regularly supplied with the following units:

Air compressor
Paint spray outfit (centralized and assigned as needed)
Scaling tool
Scaling hammer
Chipping hammer
Paint scraper
Motor car

In addition to equipment of this type, many roads are now equipping their paint gangs with sand blasting outfits. Other equipment not mentioned above that is in use by one or more roads includes electric chipping hammers, motor-car paint spray outfits, vapor spray cleaning machines and electric sanders.

Owing to the fact that many masonry structures are reaching the age where deterioration is becoming a serious factor, many roads have found it necessary in recent years to augment their masonry repair activities and numerous lines now have regular masonry repair gangs, most of which are organized on a divisional basis. A representative list of power equipment regularly furnished to such gangs is as follows:

Motor car
Air compressor
Pneumatic hammers of various types
Concrete mixer
Centrifugal water pump

On the particular road that equips its masonry gangs in this manner, a shotcreting machine and a pneumatic sheet-pile driver are centralized and assigned as needed. Equipment not listed that is furnished to masonry gangs on other roads includes concrete vibrators, grouting machines and drilling equipment.

It is apparent from replies to the questionnaire that most railroads have not felt justified in providing a great deal of power equipment exclusively for the use of their water service repair forces, although a variety of such equipment is made available generally when the need for it arises. Equipment of both specific and general-purpose nature that is used by water service forces includes air compressors, drilling rigs, pumps, power pipe threading machines, pipe pushers for underground work, electric generators, metal power shears (in shops) and welding and cutting outfits.

Special Gangs

Most railroads find it advisable from time to time to organize special gangs for performing large-scale tasks, such as deck-renewal jobs on important bridges, that are not encountered ordinarily in routine maintenance work. Because such projects usually involve many repetitions of specific operations, such as the boring of holes for lag screws, they lend themselves particularly to mechanization. In fact it is not uncommon for railroads to purchase power tools especially for use on large jobs with the thought that they will effect sufficient savings on the one project to pay for themselves. Afterwards, of course, such tools become available for use by the regular bridge and building forces.

An example of the manner in which power tools can be used to advantage on large jobs is given by the experience of a western road when renewing the deck of a long viaduct. This viaduct is situated on a double-track line and when renewing the deck it was necessary to operate single-track over it; hence it was desirable that the job be finished as quickly as possible. To this end, power equipment, including bolt tighteners, saws, wood borers and revolving cranes, was used extensively, with the result that the project was completed in one-quarter of the time that would have been required using hand methods. The cost of this project was $28,000, and

it was estimated that a saving of $4,000 was effected through the use of power tools.

Another road was faced in 1939 with the necessity of restoring six timber bridges that were destroyed during a forest fire. These structures had a total length of 1,266 ft. and a maximum height of 70 ft. The company reports that, with the aid of power tools and equipment, the bridges were rebuilt as frame structures at an estimated saving of $10,000 as compared with the expenditure that would have been required if hand labor without mechanized equipment had been used.

In recent years the electric welding process has gained wide use in the repair and strengthening of steel bridges, and many roads now include among their bridge forces at least a small welding organization, equipped with welding generators, power grinders, and, in most cases, oxy-acetylene welding and cutting equipment. On some roads the welders are attached to the regular steel gangs or they are housed in outfit cars of their own and move about as they are needed. However, at least one railroad has several large independent bridge welding organizations that travel about in outfit cars known as welding trains.

It should be mentioned that electric generators have demonstrated their value as a means of supplying power for the operation of floodlights during emergency night work. The fact that welding generators and those used for the operation of portable tools can be used for lighting purposes adds to their versatility. However, it is not uncommon for railroads to acquire generators specially for the operation of floodlighting outfits.

A development of recent years that should be given consideration in connection with the mechanization of bridge gangs is the trend toward the practice of preframing bridge timbers before treatment. Obviously on roads that have adopted this practice the amount of framing work required in the field is reduced, but on the other hand the concentration of this work at a central point provides excellent opportunities for the use of power equipment under ideal conditions. Equipment that is being used at preframing plants includes cut-off and rip saws, hand saws, planers, and tie borers and dappers. Portable outfits that can be moved about the framing yard and plant have possibilities for use at such locations. In this connection it is worth while to mention that all the advantages incident to the use of power tools in preframing timber for treatment apply also to the framing of timbers that are untreated.

Tests Conducted With Power Tools Have Demonstrated Repeatedly Their Economy as Compared With Hand Methods

Still another important development is the increasing use of automobile trucks by bridge and building forces. It has been demonstrated that the use of such trucks for transporting men, materials and equipment results in substantial savings. Here again there is wide variation in the practices on different roads. Some companies do not as yet have any trucks in service with their bridge and building forces, while on others they are being used to a limited extent, such as at terminals or by certain types of gangs. However, a number of roads have become sufficiently convinced of the advantages of highway trucks to furnish them to practically all of their bridge and building gangs.

Programming Necessary

From various sources this committee has obtained records of tests with power tools of various types, which indicate that the savings in labor as compared with hand methods range anywhere from 20 per cent to 75 per cent or more. These tests indicate clearly that the labor-saving potentialities inherent in mechanization are great, but it is obvious that if the maximum possibilities are to be realized the equipment must be used intensively. The use of specialized gangs comprises one way of achieving this result, but it may also be attained where combination gangs are used, by transferring machines from gang to gang as needed. In either case, however, it is desirable that all work be carried out in accordance with definite programs, by means of which those who are responsible for the assignment of work equipment can allot the machines in such a manner that they will be in use a maximum amount of time.

It is to be expected that the widespread introduction of power equipment will be accompanied by at least some changes in the organization of bridge and building forces, but an investigation of this phase of the subject by a committee of the A. R. E. A. failed to reveal any definite trend. Some roads reported that no changes in organization had occurred as a result of the use of power tools, while others stated that reductions had been effected either in the number or size of the gangs. On still other roads a reduction in the number of laborers has been accompanied by an increase in the number of mechanics. This investigation did develop the fact, however, that modern equipment tends to raise the standard of workmanship and requires a better trained organization and closer supervision in programming the work.

Practically all of the railroads answering the questionnaire stated that they had experienced no trouble in getting their men to use power tools; rather the experience has been that the men prefer to work in gangs that are mechanized. In this connection it is reported that the use of power tools has a noticeable effect on the ability of men to perform work. Young and able men who are in the habit of using power tools are inclined to become less adept with hand tools, whereas the less able men who would never become proficient in using hand tools can qualify with power equipment.

Equipment Still Needed

In the questionnaire the railroads were asked to indicate if there is any need in bridge and building work for types of power equipment that are not now available on the market. Several of the answers to this question mentioned the need for a suitable portable power hoist for handling heavy bridge timbers. In this

connection, one road advises that it could use a light gasoline-operated derrick that could be easily set up and removed from the track by a few men, while another would prefer to have a portable hoist or crane suitable for off-track use. A third wants a portable winch or crane, fastened to the track or mounted on a motor car, which, in addition to handling caps and stringers, could also be used for laying culvert pipe. In this connection a member of the committee points out that it is desirable to have a small crane mounted on a push car for handling the lighter steel members in bridge erection, such as floor plates and ballast stops. The availability of a machine of this type would make it unnecessary to have work-train service except for the first day of erection.

Another member of the committee feels that there is need for a machine capable of lifting the decks on steel bridges sufficiently to permit the flanges of the stringers and girders to be inspected, cleaned and painted. As he visualizes this machine, it would be self-propelled, presumably with flanged wheels, and would embody power jacks for doing the lifting. This committee member is of the opinion that, because of the extensive use of preframed treated bridge ties and other factors, it is becoming increasingly desirable that bridge decks be disturbed as little as possible, and that the use of such a machine as he has in mind would permit necessary work to be carried out on girders and stringers with a minimum of disturbance to the deck.

Other types of machines that could be used if they were available, according to the answers to the questionnaire, include a device for pulling chord and drift bolts, an electrically-operated under-water cut-off saw; a reversible electric power wrench, not exceeding 40 lb. in weight, capable of driving ¾-in. by 8-in. lag screws; and a power-operated device that would obviate the use of hand tools in finishing daps in timbers. It might be mentioned here that one road has successfully used for the latter purpose a pneumatic chipping hammer with a flat chisel-like blade.

One railroad that uses electrically operated tools extensively is working with manufacturers to develop a suitable electric nut runner for driving lag screws in guard rails and ties, and believes that it will eventually obtain a satisfactory tool. This company is also attempting to develop a satisfactory electrically-operated tool for driving nails up to the 60d size. In addition, it feels that there is a need for an electric saw for cutting piles and heavy timbers that is lighter and less cumbersome than those now on the market.

It is the conclusion of this committee that the mechanization of bridge and building forces in accordance with sound practices not only increases their efficiency and results in substantial savings, but also tends to enhance the standard of workmanship, to promote safety and to shorten the time required to complete specific projects, thereby reducing interference with train operation.

Committee—M. H. Dick (chairman), eastern editor, *Railway Engineering and Maintenance*, New York; R. D. Ransom (vice-chairman), supvr. b. & b., C. & N. W., Madison, Wis.; A. M. Glander, ch. carp., C. M. St. P. & P., Mason City, Ia.; A. R. Harris, off. engr., C. & N. W., Chicago; J. E. Hogan, asst. engr., C. & O., Hinton, W. Va.; C. E. Horrom, mast. carp., Alton, Bloomington, Ill.; Carl Kohler, supvr. bridges, Erie, Cleveland, Ohio; W. J. Martindale, for. bridges, T. H. & B., Hamilton, Ont.; A. L. McCloy, supvr. b. & b., P. M., Saginaw, Mich.; E. C. Neville, b. & b. mast. C. N., Toronto, Ont.; G. A. Rodman, gen'l. supvr. b. & b., N. Y. N. H. & H., New Haven, Conn.; G. L. Sitton, ch. engr., m. w. & s., Sou., Charlotte, N.C.; E. R. Tattershall, supvr. structures, N.Y.C., New York; J. W. Wiggins, supt. b. & b., B. & A., Houlton, Me.; J. J. Wishart, supvr. b. & b., N. Y. N. H. & H., Boston, Mass.; J. A. Wishart, asst. supvr. b. & b., N. Y. N. H. & H., Hartford, Connecticut.

Discussion

G. S. Crites (B. & O.) criticized the use of machines without regularly assigned operators, declaring that in order to maintain machines such as pile drivers and cranes in good operating condition and to derive the utmost efficiency and economy from them, it is necessary to have regularly assigned operators for each machine. J. J. Clutz (Penna.) declared that while it is very important to have assigned operators for cranes and pile drivers to insure better operation and more efficient use, he felt that there are numerous small machines which do not warrant the employment of full-time regularly-assigned operators. One plan which has been worked out very efficiently, he said, provides for a report to be prepared by the gang foreman or supervisor responsible for the recent use of a machine or piece of apparatus, when it is shipped to another gang, and for a second report to be made out by the foreman or supervisor who receives the machine. Both reports are forwarded to the officer in charge of maintenance, and in this manner, he said, a careful check is kept on the machines and good maintenance and efficiency of operation are assured.

E. C. Neville (C. N. R.) declared that it is the practice on his road to have several competent operators reporting to the supervisor of work equipment, and in instances where competent men are not available on divisions where machines are to be assigned, operators are furnished by the supervisor of work equipment. K. L. Miner (N. Y. C.) reported extensive use of lineograph machines to paint safety limit lines on passenger platforms and to define parking zones in and about passenger and freight stations, declaring that a machine and one operator can paint 4,000 lin. ft. of striping in a day. Replying to a question regarding the use of trucks in bridge and building work, Mr. Crites described a pooling system employed at the Baltimore terminal of his road where the trucks are used very efficiently under the direction of a truck dispatcher.

Bridge and Building Supply Association Exhibit

TWENTY-FOUR manufacturers of equipment and materials used in the construction and maintenance of railway bridges, buildings and water service facilities, presented an exhibit of their products, under the auspices of the Bridge and Building Supply Men's Association, in connection with the forty-seventh annual convention of the American Railway Bridge and Building Association, at the Hotel Stevens, Chicago, on October 15-17. The officers of the Supply association who arranged for and were responsible for the exhibit, which was held in the exhibition hall immediately adjacent to the convention room were: President, Harry A. Wolfe, special representative, The Lehon Company, Chicago; vice-president, C. C. Rausch, representative, Dearborn Chemical Company, Chicago; secretary, W. S. Carlisle, representative, National Lead Company, Chicago; treasurer, H. M. Winandy, assistant manager railway

sales, Celotex Company, Chicago; and the following members of the executive committee—honorary director, K. T. Bachelder, manager railway sales, Insulite Company, Chicago; G. W. Anderson, representative, Patterson-Sargent Company, Chicago; C. E. Ward, representative, U. S. Wind Engine & Pump Company, Batavia, Ill.; A. J. Filkins, president, Paul Dickinson, Inc., Chicago; F. A. McGonigle, manager railway sales, Mall Tool Company, Chicago; P. R. Austin, representative, Johns-Manville Sales Corporation, Chicago; and Ross Clarke, sales representative, Massey Concrete Products Corporation, Chicago.

Harry A. Wolfe
President

In the election of officers for the ensuing year, Mr. Rausch was advanced to president; Mr. Carlisle was elected vice-president; R. Y. Barham, district manager, Armco Railroad Sales Company, Inc., Chicago, was elected secretary; and Mr. McGonigle was elected treasurer. The new directors elected were: E. C. Bleam, representative, Joseph Dixon Crucible Company, Chicago; and E. E. Thulin, E. E. Thulin Company, Chicago, to succeed Messrs. Anderson and Clarke whose terms had expired.

A list of exhibiting companies, together with the products on display, and the names of their representatives follows:

List of Exhibitors

Air Reduction Sales Company, New York—acetylene welding outfit; flame cleaning tip; electric welding unit—C. B. Armstrong, C. Daly, J. Kenefic, J. G. Magrath and E. F. Turner.

American Lumber & Treating Company, Chicago—samples of Wolmanized timber and illustrations of its use—Robert R. Clegg and R. B. Putman.

Armco Railroad Sales Company, Middletown, Ohio—samples of Armco pipe and illustrations of applications—C. H. Anderson, R. Y. Barham, E. T. Cross and E. Harbeck.

Buda Company, Harvey, Ill.—earth drill; Klinch-Klaw jack; track and car jacks—R. M. Blackburn, H. H. Cohenour, J. S. Dempsey, R. B. Fisher, F. Gormley, W. A. Hart, R. K. Mangan, S. W. Sanford.

Celotex Corporation, Chicago—insulation; wallboard; cold storage insulation; interior finish—J. H. Bracken, W. S. Millener, W. G. Rogers and H. A. Winandy.

Dearborn Chemical Company, Chicago—No-Ox-Id rust preventives; sealing compound for wood water tanks; aluminum protective coating; pipe coating, wrappers for protection of underground pipe; chemical pumps; proportioner—Don Bishop, C. I. Loudenback, A. C. Moeller and C. C. Rausch.

Paul Dickinson, Inc., Chicago—roof ventilators; smoke jacks; stove jacks; roof drains; exhaust heads—A. J. Filkins, E. M. Filkins and William Harrison.

Joseph Dixon Crucible Company, Jersey City, N.J.—industrial paints—E. C. Bleam, R. E. Goodfriend and W. Skea.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.—bridge jacks—C. N. Thulin and E. E. Thulin.

Homelite Corporation, Port Chester, N.Y.—portable pumps; generators and blowers—R. J. Edbrooke, R. C. McDonald and Nelson Thompson.

Johns-Manville Sales Corporation, New York—samples of transite pipe; corrugated transite roofing and siding; asbestos roofing and siding shingles; transite conduit; asphalt tile flooring; asphalt shingles; built-up roofing; prepared roofing; pipe insulation; asbestos wainscoting and wall board; mechanical packing; asphalt plank—P. R. Austin, R. J. Offutt, T. O'Leary, Jr., H. R. Poulson, W. W. Prosser, F. C. Vandervort and L. T. Youhn.

Lehon Company, Chicago—asphalt shingles; asbestos shingles; prepared and built-up roofing; aluminum paint; waterproofing materials—John Eipper, Tom Lehon, T. L. Kennedy, E. A. Leonard, R. J. Mulroney, John W. Shoop and Harry Wolfe.

Mall Tool Company, Chicago—gas-driven and electric-driven machines for vibrating concrete and surfacing concrete, with attachments for grinding, pumping water, drilling, boring, driving lag screws, wire scratch brushing and sanding; pneumatic chain saws and cross-cut saws; electric saws; drills; grinders; and chain saws—Robert Burgwald, A. W. Mall, F. A. McGonigle, M. Rehnquist, M. S. Riley and James Stewart.

Massey Concrete Products Corporation, Chicago—literature on concrete pipe, piling, concrete cribbing and crossing slabs—Ross Clarke, David A. Hultgren and W. L. McDaniel.

Master Builders Company, Cleveland, Ohio—samples of floor wearing surfaces; rust joint iron; non-shrink aggregate for concrete bonds; reground portland cement paint for concrete surfaces; liquid quick-setting compound; puzzolanic water-reducing agent for mass concrete; membraneous curing compound; masterplate floors—L. W. Johnson, D. H. Lee and B. R. Wood.

National Lead Company, New York—red lead; white lead; linseed oil; colors in oil; lead mixing oil; literature on red lead paints and the use of white lead—Ralph Baker, W. S. Carlisle and Hugh M. Millen.

W. S. Carlisle
Secretary

Oxweld Railroad Service Company, Chicago—flame cleaning apparatus; soldering and brazing outfit; complete welding and cutting outfit—Lem Adams, F. J. Duffie, F. Finsthwait, E. B. Hall, Jr., S. B. Hopkins, G. B. Moynahan and D. H. Pittman.

Patterson-Sargent Company, Chicago—bridge paints; and literature on bridge paint—Geo. W. Anderson, Ben Bowman and W. H. McBride.

Pocket List of Railroad Officials, New York—B. J. Wilson.

Railway Engineering and Maintenance, Chicago—copies of publication—G. E. Boyd, M. H. Dick, S. W. Hickey, N. D. Howard, E. T. Howson, C. W. Merriken, H. A. Morrison, and J. S. Vreeland.

Ruberoid Company, Chicago—Geo. R. McVay.

Timber Engineering Company, Washington, D.C.—timber connectors; termite shields; and literature on connectors and timber design—J. B. Jordan and L. P. Keith.

U. S. Wind Engine & Pump Company, Batavia, Ill.—frost casing for riser pipes; tank stuffing box; float valves—C. E. Ward.

Warren Tool Corporation, Warren, Ohio—flex-toe claw bar—W. H. Bon, F. H. Lehman and Oscar Youngquist.

WHAT'S the Answer?

Purchasing Track Shovels

Should track shovels be bought to railroad specifications or selected by brand name? Why? Do the test requirements of specifications insure satisfactory shovels? If not, what forms the best basis for selection?

By Brand Name

By P. O. Ferris
Chief Engineer, Delaware & Hudson, Albany, N. Y.

Experience with both specification shovels and those purchased by brand name has convinced me that these tools should be purchased by brand name from reliable manufacturers. My reason for making this statement is that it is thus possible to secure a more satisfactory product at less cost. We discontinued specification shovels for this reason. It is obvious that the manufacturer can assume no responsibility for failures and short service life of shovels which he makes according to specifications prepared by the purchaser. On the other hand, to preserve the reputation of his product, the manufacturer will usually replace failed shovels bearing his trade mark and make proper restitution where they have failed to give proper service.

Purchase on Brand

By G. R. Westcott
Assistant Engineer, Missouri Pacific, St. Louis, Mo.

It is a common practice to purchase materials on specifications and a wide variety of materials are purchased in this way; under some conditions this method is of decided advantage. Where the article to be purchased is complicated in design or the requirements for it are not well known, specifications serve better than any other means to give the manufacturer a full and correct understanding of the requirements that must be met. On the other hand, where the design is simple or the device is well known, the advantages of buying on specifications are less marked.

Successful use of this method of making purchases presupposes three conditions, namely, the fitness of the thing purchased must be capable of determination by laboratory tests; the specifications must include the requirements and procedure for these tests; and prior to or simultaneously with the delivery of the material there must be an adequate inspection, including the required tests. Failure to include or meet any one of these conditions means the complete failure of the method.

Track shovels do not constitute a new device, and manufacturers are fully informed of the requirements that they must fulfill. From this viewpoint, therefore, there is no need for specifications. But of greater importance, there are no simple laboratory tests that have come into general use for determining with certainty the service that may be expected from a shovel that has passed the test successfully.

It is true that hardness tests will determine reasonably well what resistance to abrasive wear may be expected, and stressing tests will give some idea of the strength of the metal and its ability to withstand shock. In actual service, however, the use of a shovel for shoveling is often only incidental, for it may be used to dislodge cementing ballast from the sides and ends of the ties, for tamping light ballast and, too often, to nip ties. These uses result in a constant flexing of the blade, and failure often follows from these forms of abuse. At least one manufacturer has used a flexometer to demonstrate the resistance of his product to failure from flexing. A description of this apparatus and of the nature of the test

Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered in January

1. *Should maintenance of way employees be examined on safety rules? Why? If so, who should take the examination? At what intervals?*
2. *What are the relative advantages and disadvantages of concrete and vitrified brick for paving turntable pits?*
3. *On a branch line laid with light rail, is there any advantage in using rail of heavier section for the turnouts? Why?*
4. *What are the relative advantages and disadvantages of inside guard rails and outside guard timbers on open-deck bridges? How should they be placed?*
5. *To what extent is it feasible to use motor trucks for handling snow? In what ways?*
6. *What is the difference between a volute and a turbine pump? For what service is each best adapted?*
7. *How can one determine how frequently stone ballast should be cleaned? What benefits ensue?*
8. *When wrecking buildings, what methods should be followed to insure maximum salvage?*

might be included in the specifications, but considerable expense would be involved in providing the equipment and making the test.

A reputable manufacturer selling a shovel under his own brand name is jealous of its reputation and, since he knows that the reputation of the brand and of the products to which it is applied depends on satisfactory service, he is far more likely to put quality into his product than the manufacturer whose aim is largely to pass an inspection based on specifications, and in doing so to cut the cost of manufacture below that of his competitor whose objective is the same.

There are certain advantages in having only one brand of shovels on a railway, principally in the matter of replacing broken handles, but this is not of great importance. To insure competition in purchasing, it is generally advisable to select several well-known brands, each of which has been proved to be satisfactory by actual service, and set these up as acceptable. This narrows the competition somewhat, but assures a satisfactory product at a price as low as manufacturing costs will permit. It should not be ignored in this connection that the manufacturer must maintain quality to keep his brand on the accepted list and must also make his price reasonable to retain the business.

Replacing Wire Rope

How does one determine when a wire rope needs to be replaced? What are the most common causes of failure?

Change End for End

By W. C. Harman
Supervisor Bridges and Buildings, Southern Pacific, San Francisco, Cal.

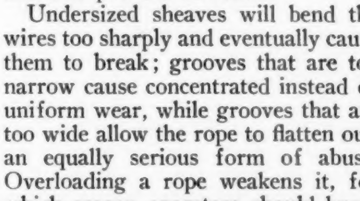
Wire rope should be replaced whenever the wires in the strands are worn a sufficient amount to impair its lifting or holding capacity. I consider that this point has been reached when the wires of the strand are worn 30 to 40 per cent. At any rate, at this time the rope must be watched closely, as it is then that the wires begin to crack and a close inspection will disclose that many of the wires are breaking, a condition not conducive to safety.

It must be kept in mind that all of the wires of the strand are subject to the same wear at the same point in the line where the twist brings them to the surface of the rope. However, that section of the line working over the boom sheave gets the most severe wear. For this reason, this part of the rope should get the closest inspection. The other end of the line on the drum must not be overlooked, for it too will need attention. The boom line especially, should be run off the drum so that the inspection can cover this end as well. If it is not given proper care, it will become set and corrosion will be likely to attack the inner wires, weakening them to an unknown extent, thus setting the stage for a serious accident.

It is a common practice, and an essential one, to change the lines end for end at relatively short intervals so that both ends will receive the same amount of wear. Ropes that have been kinked should also be watched closely, since a line that is once kinked is no longer reliable. The same comment applies to a rope that has been "snaked," as this indicates that it has been overloaded and badly stretched, and should be regarded with suspicion.

Some of the more common causes of failure in wire ropes are lack of lubrication, working sheaves that are too small in diameter, overloading the lines, kinking, grooves of improper width, and wear. Directions are given by all wire rope makers regarding the lubrication of the line. This means, of course, that the hemp core of the rope should be kept saturated with light oil, which in turn will lubricate the wires on the interior of the rope and also prevent corrosion.

Undersized sheaves will bend the wires too sharply and eventually cause them to break; grooves that are too narrow cause concentrated instead of uniform wear, while grooves that are too wide allow the rope to flatten out, an equally serious form of abuse. Overloading a rope weakens it, for which reason operators should know the capacity of their lines and be careful to avoid overloading them. Kinking accounts for many failures that are attributed to other causes. When a line is allowed to become kinked, the structure of the metal in the wire is disarranged in such manner and to such an extent that it will no longer serve the same purpose that it did before the damage occurred, no matter how nearly perfect it may appear to be. It is important that wire ropes be given frequent and close inspection, for in railway service, under the best of conditions, they are abused.



Many Signs of Failure

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

There are many signs of approaching failure in wire rope which, alone or in combination, act as a warning, especially if proper care has not been exercised to keep the rope in good condition. Rope that has not been properly lubricated will show wet, muddy-appearing streaks when under load. This form of failure starts with the inner wires and the muddy streaks indicate that corrosion is occurring to such an extent that the rope should be replaced.

Where sheaves of a diameter too small for the rope have been used, excessive bending stresses occur and they will be indicated by cracked wires. If the groove is too narrow, the rope will be pinched and excessive wear will occur on the outer strands. If the groove of the sheave is too wide for the diameter of the rope, the rope will flatten through lack of side support, and some of the strands will be overstressed, especially if a load is picked up with a side swing. When applying a new rope, it should be straightened by unrolling it from the coil; it should not be uncoiled, for this will be certain to cause it to kink.

Many failures have occurred because the foreman or operator has been misled into believing that the rope was in good condition by the appearance of the outer surface. Where there are local reductions in diameter; a loosening of the twisted coils; spotted muddy streaks when under load; or a pitting, through corrosion, of the outer strands, generally by reason of inadequate lubrication, these are indications of approaching failure and the rope should be replaced. Safety demands that there be no temporizing with a rope that is beginning to show such defects or excessive wear.

All wire ropes should be lubricated thoroughly with a penetrating type of lubricating oil. If a rope is applied on a structure, and its use is required for only short periods between relatively long intervals, after the pene-

trating lubricant has been applied, it should be followed shortly with a liberal application of a sealing compound or cable dressing to protect the outer strands and to prevent the penetration of moisture to the inner strands. The overloading of rope in any service should not be permitted, and a rope that has been lying idle for a long time should be tested carefully for strength before it is returned to service for handling loads.

Adzing Ties on Curves

When laying rail, is it good practice to adz ties on curves to obtain more cant for the inside rail than is afforded by the cant of the tie plates? The outside rail? Why? How much?

Keep in One Plane

By A. N. Reece
Chief Engineer, Kansas City Southern, Kansas City, Mo.

When laying rail, where canted tie plates are used, it is not good practice to adz ties on curves to obtain additional cant for either the inside or the outside rail. When laying either new or released rail ties should be adzed level to permit the tie plates to rest evenly on the ties; the only exception to this should be where either no tie plates are used or the tie plates are not of uniform thickness and do not provide a proper rail bearing. In the event that the tie plates are not of uniform thickness, adzing may be permitted to afford the running surface of the rail a more even coverage by the wheel tread.

With the present machine adzing of the ties at the treating plants before treatment, and the use of mechanical adzers to smooth the ties for a uniform bearing for the tie plates when laying rail, any adzing to adjust ties to afford more cant to the rail will do a great deal of damage to the ties and will also be likely to produce a non-uniform surface for the bearing on the ties. It is my conclusion, therefore, that only in cases of extreme emergency should any further adzing be done to produce a greater cant in the rail than is afforded by the tie plates in use.

Is Not Desirable

By H. F. Fifield
Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

It is not our practice to adz ties when laying rail, to obtain more cant for either the inside or outside rail, than is given by the tie plate. My belief is that the tie plates are of the size and have the cant specified by the railway, and the cant that is needed to suit the traffic conditions should be specified, so far as possible. Any adzing that changes the cant of the plate will be more or less a hit-and-miss proposition, especially if done by hand. If done with a power adzer it would be necessary to make frequent changes in the position of the cutting head, since the cant required on an easement curve will not be the same as that required at the point of full curvature or on tangent. This tipping of the tie plate will not afford a uniform bearing of the wheel tread on the running surface of the rail, which I believe is desirable.

Hold to Standard

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This question touches upon a practice that is more prevalent than most of us realize, and one that should not be permitted. Few will deny that some cant is needed to provide proper contact between the wheel tread and the running surface of the rail. Exactly how much is a matter of debate, as is witnessed by the fact that the variations in cant on different roads range from 1 in 20 to 1 in 44. The important point is that whatever cant is specified should be maintained and local officers should not be allowed to violate the standard.

Obviously, the lateral forces acting on rail are greater on curves than on tangents, for which reason, in the past, rail on curves has shown a greater tendency to tip than on tangents. In not a few instances the trouble has been acute. The practice of adzing to cant the rail on curves goes back to the days before tie plates were in use. The early tie plates were so inadequate in area that the rail continued to tip and the practice of adzing to produce cant was continued. Even the first of the canted tie plates allowed the rail to tip. Today, however, our tie plates are of ample area and, if correctly designed, will resist the action of the lateral forces. There is no reason, therefore, why adzing to produce more cant on curves should be allowed and there are many reasons why it should not be allowed.

Does Not Favor

By George Stafford
Section Foreman, Canadian National, Redland, Alta.

Observation of the behavior of rail in the track since the adoption of the canted tie plate, shows a material reduction in the amount of batter, flow and wear caused by overstress induced by insufficient bearing area between the wheel and the running surface of the rail. From the standpoint of maintenance, the practice referred to in the question is objectionable. No tie, whether it is treated or untreated, that is adzed after it is installed in the track will have the same service life that it would have had if it had not been adzed, and each successive adzing shortens its life still further.

Prebored ties will also suffer injury from the suggested practice, for if the spikes are driven at right angles to the rail base, as they should be, they will take a path at variance to the direction of the boring. Furthermore, after a few years the question of tie renewals will be involved. When renewals become necessary, unless the old-fashioned method of adzing by hand is revived, which is wasteful in both labor and material, to obtain the desired cant, a certain number of ties will have to be ordered every year, of specified cant in the adzing and with special boring, and handled separately for the curves.

Obviously, it will be far better to specify plates having the desired cant. If a standard is established, it should be followed; otherwise maintenance practices will become chaotic. In this connection, it should be borne in mind that excessive cant carries the same penalty as no cant, and that this penalty may be far more severe. Both rails should be given the same cant, and if the tie plates are designed with

sufficient area, there is no reason why the rail on curves needs more cant than that on tangent. In other words, where the cant of the rail on curves appears to need adjustment, the trouble is more likely to be that the tie plates are of insufficient area than that the cant is wrong.

Faster Delivery of Water

What steps are necessary to provide faster delivery of water to large locomotive tenders?

Must Increase Flow

By Water Engineer

Faster delivery of water to locomotive tenders means increased flow of water through the water column and through the water main which serves it. If the delivery pipe remains unchanged, it will be necessary to increase the velocity of flow to obtain an increased volume of flow. This, in turn, demands an increased head in the tank. To get a high rate of delivery to locomotive tenders, it is desirable to avoid increasing the velocity of the water, if this is practicable. This can be done by increasing the size of the water column, and of the delivery main. It is also desirable to locate the storage tank close to the water column where practicable, to cut down friction losses. As a last resort, it may be desirable or even necessary to increase the head of delivery to secure increased flow.

Head Most Important

By R. C. Bardwell
Superintendent Water Supply, Chesapeake & Ohio, Richmond, Va.

When made from a roadside tank, the delivery of water to locomotive tenders can be increased as desired by increasing the opening in the outlet valve. Delivery through water columns depends in largest measure on the head available, and this in turn depends on the height of the water in the storage tank and the friction in the delivery mains; this again depends on the size, length and condition of this pipe line. This actual size of the water column is often credited with being the controlling factor, but the modern telescopic-spout water column does not have much more influence on the rate and quantity of delivery than a properly designed fire hose has on the fire stream from a line of fire hose.

Formerly, when the time required to take water was not considered important, many facilities were installed with mains of small size; in other cases incrustation has decreased the available pipe opening. As an example, the delivery of 4,000 gal. a min. through each 100 ft. of pipe will require a head of 40 ft. for 8-in. pipe; of 15 ft. for 10-in. pipe; of 5.5 ft. for 12-in. pipe; of 2.5 ft. for 14-in. pipe; and of 1.3 ft. for 16-in. pipe. Therefore, it will be desirable to have the storage tank as close as practicable to the point of delivery. This will tend to increase the volume of flow in the pipe, but it may also be necessary to increase the size of the pipe to avoid dissipating the head by friction losses.

The delivery of the water into the tender is through a flexible connection, usually a sheet-iron telescopic spout, which is open at both ends and cannot be anchored. The rapid delivery of a large volume of water through this spout creates a certain hazard in the handling of it. It is generally considered that the maximum safe delivery is between 3,500 and 4,000 gal. per min., although this rate has been exceeded successfully in some cases.

Lumber for Scaffolds

What species of lumber are best suited for staging and scaffold? Why?

Avoid Inferior Material

By V. Engman
Chief Carpenter, Chicago, Milwaukee, St. Paul & Pacific, Savanna, Ill.

Staging and scaffolds must be designed and constructed in such manner that they will support safely the workmen who are required to use them, together with the tools and materials they require for the work they are doing. Accordingly, no attempt should be made to economize through the use of inferior lumber. Because these structures are temporary in character, there is too often a tendency to overlook their importance and to fail to exercise the care that should be given to their erection, forgetting that faulty construction, combined with inferior material, invites accidents.

From the standpoint of economy, the same kind of lumber that is to be used in the job should be used for the scaffold and staging. Douglas fir and southern pine, the species most commonly used for construction and maintenance, are equally well suited for scaffold and staging. Both species have sufficient strength for this purpose; they possess good nail-holding power; and are not too heavy for ready handling. In general, out of stock run or job lot, enough pieces can be selected, that are straight grained and free from weakening knots or other defects, to construct the needed staging or scaffold. The use of doubleheaded nails lessens the chances for the lumber to split, and through their use the lumber can be salvaged with little loss.

Prefers Red Cypress

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Since safety is paramount in all classes of work, the inspection of lumber for staging and scaffolds becomes of the highest importance, to insure straight-grained material of the right dimensions to support the load that will be imposed upon them. Those not actively engaged in the work are sometimes surprised to learn that a large percentage of the work performed at bridges and around buildings requires scaffolding.

I know of no better lumber for use in staging and scaffolding than southern red cypress, with straight grain and free of knots. Boards of this wood have equal or greater strength than any other species of equal weight.

It is our practice to use scaffold boards 3 in. by 12 in. by 16 to 18 ft. long, of dry red cypress clear of knots and with grain as straight as can be secured. This material will carry safely any reasonable center load over a span of 12 to 14 ft. It is light to handle and will last a long time for swinging scaffolds. For swinging scaffolds for timber trestles we also use second-hand 3-in. pipe needle beams about 22 ft. long, thus

allowing us to place the scaffold plank on both sides of each of two adjacent bents. These pipe beams are swung to the required height by means of 1-in. manilla rope which is passed through an eye-bolt 4 in. from each end of the pipe and then fastened to sound timber overhead, with the wraps and knots necessary to prevent slipping. The scaffold boards have a drop bolt or pin to hold the boards in place by preventing longitudinal movement. Scaffolds of the type described are used on all classes of bridge work.

Where it becomes necessary to erect scaffolds for the purpose of constructing or repairing buildings, water tanks or other structures, it is important that the upright pieces or posts be placed on a solid foundation. In the southern states, the material most generally used for bracing is yellow pine, and it performs quite satisfactorily. One should be careful, however, not to allow cross-grained or knotty material to be used for this purpose.

Crossbars or bearers which carry the platform upon which the men must work should be straight grained, free of knots, of the required width and thickness, and should be attached to the uprights by means of bolts. Dependence should not be placed in nails for fastening crossbars, because vibration or shock may break the nails or pull them from the uprights. Where scaffolds are assembled by means of nails there is always danger that they may fail.

Southern pine is most commonly used for crossbars and posts in the section of the country with which I am most familiar, and is quite satisfactory for this purpose. However, as before, the material for the platform or boards that the men must be moving over constantly with material and tools, should be of clear straight-grained red cypress. This timber is light and the boards can be shifted from place to place easily and quickly when this becomes necessary.

Should be Light

By Supervisor of Bridges and Buildings

Material for staging and scaffolding must fulfill several requirements: it must be reasonably light, so that it can be handled easily and readily; it must be free from defects, such as knots, bad grain, splits, decay, etc., that might impair its strength or otherwise make it unsafe for this use; it must also be of sufficient size to insure the needed strength.

Oak and similar woods are barred by the requirement of lightness. White pine meets all requirements, but costs too much to be used in temporary structures. In the East I have found hemlock to be an excellent substitute for white pine, while in the South and West, my experience has been confined to yellow pine and Douglas fir and both have been satisfactory. I have also heard of spruce being used in this service with success, but have never seen it so used.

Making the Tie Inspection

To what extent should the supervisor and division engineer participate in the annual tie inspection? Why?

They Should Know

By C. D. Turley
Chief Tie Inspector, Illinois Central, Chicago

It is the duty of the division engineer to keep his superior officers advised of the general tie conditions on his division and of the probable requirements for the following year. It is not possible for him to do this properly unless he is himself acquainted with the facts that he must pass on. Tie inspection should be made in the fall after tie renewals for the year have been completed, ordinarily late in October or early in November. The information secured in this inspection provides the basis for definite recommendations to the management as to the tie requirements for the following year.

The section foreman who is most intimately familiar with the general condition of his track and with the demands that are being made on it, should make the original inspection and recommendations for tie renewals, recording these data by miles. The track supervisor, who is likewise familiar with the track on his district, should discuss the proposed renewals with the foreman and should make a joint check with him of a part of his section.

Next, the division engineer, who is responsible for tie conditions on the entire division, should explain in advance to the supervisor the plan and policy to be followed. He should also check a portion of each district with the supervisor to make sure that the instructions are understood and are being followed, and that the supervisor's recommendations will insure a safe and reasonably uniform tie condition throughout the district.

With few exceptions, the tie allotment authorized by the management will be based on the recommendations of the division engineer and the supervisor, and these in turn are based on the tie inspection. If a safe and uniform tie condition is to be maintained throughout the system, the supervisor and the division engineer must participate in the annual tie inspection to the fullest extent reasonably possible.

Big Chance for Waste

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Ties and the labor connected with their renewal constitute the largest single item of expense in track and roadway maintenance. For this reason, especially at a time when it is important that all items of expense be watched, it becomes of more importance that this, the largest one, be given close attention, particularly since one cannot find as many opportunities for waste anywhere else in maintenance.

The section foreman is the key man in the annual tie inspection. He goes over his track daily, he knows the requirements of his track and is most familiar with his tie condition. He should, therefore, initiate the inspection. Like every one else, however, it sometimes happens that he allows this very familiarity to color his views with respect to his needs. This makes it desirable that his inspection be supervised rather closely, and this is the duty of the supervisor, who normally has a somewhat wider outlook than the foreman and who must co-ordinate the recommendations from all of his foremen. In some cases, the supervisor can accompany the foreman on the inspection. If this is not possible or convenient, he should select at least two miles on each section on his district upon which to check the foreman's recommendations.

The division engineer is definitely in the picture, for he is responsible for the tie condition and the tie costs for the whole division. It is not necessary

that he give the same detailed attention to the inspection as the foreman and supervisor, but he should be thoroughly familiar with his tie conditions and should, therefore, make a personal check of certain miles on each supervisor's district. On the Chesapeake & Ohio this check is made by the assistant engineer maintenance of way, the engineer of track, the general inspector of track and the division engineer jointly, in the presence of the supervisor and the section foreman. In addition, this trip enables these officers to inform themselves on many details with which they might not otherwise be able to have personal contact.

Must Know Details

By Engineer Maintenance of Way

I consider this a question of primary importance, for it touches an item of large expense which requires constant attention on the part of all of the officers involved to insure that this expense will be kept under control. It is obvious that to keep an expenditure under control, those whose duties it is to do so must be familiar with the details of what constitutes the expenditure and equally familiar with the operations that are causing it currently.

I am not in favor of alien tie inspectors. The section foreman, being responsible for his track conditions and intimately familiar with his ties, should be the man to make the original inspection. I am not in favor of allowing the supervisor to accompany him, unless he is newly appointed and is as yet wholly unfamiliar with his track. Even in the tie inspection, the foreman should stand on his own feet, and not lean on his supervisor. I believe in giving a man full responsibility and then expecting him to assume it. Restricting his actions restricts his ability to assume responsibility. Obviously, however, the foreman needs some supervision, and this is supplied by requiring the supervisor to check his estimate of the ties he will require. He can do this by checking, say, two miles on each section, and I would have the foreman accompany him while this check is being made.

Just as the foreman and supervisor are responsible for their respective territories, the division engineer is responsible for the whole division and should be familiar with the conditions on it. Obviously, he cannot spend the time necessary to check every mile, especially as some divisions today are very large. He should, however, select, or pick at random, enough miles on each supervisor's district to give a typical view of the recommendations, and make a detailed check of the tie estimates for the individual miles. Only in this way can he have a real appreciation of the tie requirements for his territory or understand the degree of economy with which tie renewals are being made on the several districts and sections.

Ratio of Risers to Treads

What relation should be maintained between the risers and the treads of a stairway? Why? When should a ramp be substituted for a stairway?

Is Not Fixed

By Frank H. Soothill
Chief Estimator, Building Department, Illinois Central, Chicago

The proper relation between the dimensions of stair treads and risers is shown graphically by the accompanying diagram. If, in the right-angle triangle ABC, AB equals 24 in., and BC equals 11 in., the diagram will give the standard dimensions of risers for any width of tread.

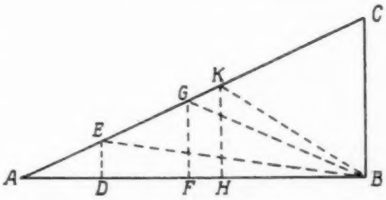


Diagram for Determining Height of Riser and Slope of Ascent for Various Widths of Tread

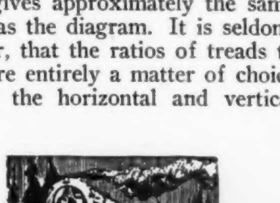
To determine the height of the riser to correspond to a given width of tread, set off on AB the width of the tread, BD. From D, erect the perpendicular DE, intercepting the hypotenuse at E. Then DE is the height of the riser for this width of tread. Now join B and E, and angle DBE is the angle of inclination, indicating the slope of ascent. Similarly, the height of the risers FG and HK for treads having widths equal to BF and BH and the slopes BG and BK for the corresponding ascents can be determined.

Similarly, these ratios can be obtained from the accompanying table, which gives approximately the same results as the diagram. It is seldom, however, that the ratios of treads to risers are entirely a matter of choice because the horizontal and vertical spaces allotted to stairs usually determine the ratio for a particular building. Where both the vertical and horizontal distances of a staircase are fixed, it is obviously possible only to approach the theoretical ideal.

Ratio of Height of Risers to Width of Tread

Width of tread in inches	Height of riser in inches
5	9
6	8½
7	8
8	7½
9	7
10	6½
11	6
12	5½
13	5
14	4½
15	4
16	3½
17	3
18	2½

There are two main factors that tend to influence the substitution of ramps for stairs: (1) Where a long run and a short rise are encountered, which will produce an inclined surface with a gradient of 10 per cent or less for interior use and not exceeding 3 per cent for exterior use; and (2) where a large volume of pedestrian traffic must be handled rapidly. Incidentally, for the second condition the ramp will be far safer than a stairway.



Many Rules

By General Inspector of Buildings

Peculiarly, while there are many rules for proportioning risers to treads, a composite diagram embodying those in most common use will show that they fall within a surprisingly narrow range. However, some of those that are not used so widely may fall well without the band occupied by the more common ones. When I first started in railway service, we had an architect who invariably used a fixed ratio of 6 to 10 for his risers and treads. For ordinary stairs this is not particularly objectionable, but as the treads increase in width the height of the risers increases also, instead of being reduced, making the ascent tiresome; the rule is unworkable, for stairways that must be steep.

Other rules include one making the

width of the tread plus twice the height of the riser equal 25. This makes a comfortable stair that is easy to ascend or descend. Obviously, however, with this rule, as with all others, where the horizontal distance is restricted, and the stairs must be made steeper than desirable, these proportions must be varied or discarded, as the case may be, to make the stairs fit the space allotted to them.

The common width of tread, or run as it is generally known, is about 10 in. This was the reason that the ratio of 6 to 10 was satisfactory in the majority of buildings. The run may be less where the horizontal space is limited and more for interior stairways in public buildings or for outside stairways or short flights of steps. As a matter of fact, for this run the rise may vary from 6 to 7½ in., the latter being used more commonly. However, not a few designers determine the rise by the rule that the sum of the rise and run shall equal 17½ in. It will be noted that this rule is similar to the one that the run plus twice the rise shall equal 25 in. The slopes obtained from the use of these two rules are identical only when the width of tread is 10 in.

Still another rule is that the product of the riser multiplied by the run shall equal 70 in., while another makes this product 75. Strangely enough, this difference makes a rather wide difference in the relation between the risers and treads, but the difference remains nearly constant for all practical runs, while with the other rules, this relation varies for all differences in the width of the treads.

Ramps should be used for all slopes that are too flat to make steps practicable; for passages between different elevations that must carry a large traffic expeditiously; for other slopes that are 20 deg. or less with the horizontal, except on outside walks that may be covered with sleet or ice from melting snow.

Detachable Snow Brooms

What is the most satisfactory type of snow broom? Are detachable handles practicable?

Are Not Practicable

By I. H. Schram
Engineer Maintenance of Way, Erie, Jersey City, N. J.

We have recently prepared specifications for a design of broom that serves both as a snow and a switch broom. The brooms purchased under this specification have given excellent satisfaction and, since they may be of interest to other maintenance men, I am quoting them in full:

Material.—Snow and switch brooms shall be made of the best quality of palm fibre, and shall be cut carefully to uniform length.

Handles.—Handles shall be of warehouse size of either the straight-taper or parallel pattern, 42 in. long, and not more than 1-3/16 in. in diameter at the bottom for the straight-taper type, and not more than 1⅛ in. in diameter at the bottom for the parallel type. They shall be of straight-grained maple, beech or ash, of mill run quality or better. When a chisel point is specified, the over-all length shall be 53 in.

Construction.—The body of the broom shall be fastened securely in a metal case, with an additional metal band fastened securely around the broom fibres below the metal case; it shall be not less than 15 in. long, or more than 16 in. from the shoulder to the tip; and it shall be 12 to 13 in. wide at the sweeping width.

Sewing.—The best quality of well-waxed Italian flax, with two strings in each sewing, shall be used, and the broom shall be sewed four times, equally spaced, below the metal.

Weight.—The minimum shipping weight when dry shall be not less than 32 lb. per dozen.

The palm fibre broom is used universally, is available for either cleaning switches or general sweeping of snow, and has the longest life, with a cost comparable to other types. Corn brooms wear out too quickly and are too expensive for snow service. Rattan brooms absorb moisture, freeze and the splints curl up; these brooms have a very short life.

Detachable handles are not practicable, and brooms of this design are too expensive for use in fighting snow. At some places the chisel point is advantageous for cleaning out flangeways at crossings and turnouts, and is specified. This device makes it unnecessary for a man to carry two tools to an outlying location.

Does Not Favor Them

By District Engineer

I fail to understand why anyone would want a snow broom with a detachable handle. I presume that the basis of the suggestion is that snow brooms wear out rapidly in service and that because of this high casualty rate many perfectly good handles go to waste; this is correct. This attitude brings to mind the superintendent who returned from a meeting in which the theme of economy was stressed, and in this enthusiasm wrote to every agent on the division that if he would save only one match a day, so many boxes of matches would be saved in a year and, for the system as a whole, the result would be truly astonishing if every one co-operated fully. When the next monthly requisitions were received, it was discovered that every station agent had ordered matches; not one of them had known previously that the company disbursed matches.

In the same way, if the idea is to save money by using detachable brooms and salvaging the handles, it is a mistaken one, for this type of broom is too expensive. In any event, the man who is engaged in fighting snow is generally too busy to give much thought to the salvaging of materials. When a broom of any design becomes too worn for further service, it is cast aside for one that is usable. Furthermore, from the viewpoint of use, this type is not practicable, for what the trackman wants is a solid dependable tool, not one that may come apart, as such brooms have been known to do, when he is busiest.

As to the kind of broom, none are entirely satisfactory, for in snow service two qualities are demanded that are difficult to build into brooms—stiffness without brittleness, and a certain amount of pliability. Corn brooms will not stand up under snow service; they do not wear so much as they fray. Wire brooms are too inflexible, and when the individual wires bend the broom cannot be used. The rattan broom is superior to either of these two, but has the disadvantage that the rattan strands break and curl up, destroying the usefulness of the broom. Brooms made of palm fibre, while not completely satisfactory, are the best we have used, but they must be well and tightly sewed to prevent fraying, as in the corn broom.

Products of Manufacturers

Replaceable-Tip Screw Drivers

STANLEY Tools, Division of the Stanley Works, New Britain, Conn., has perfected a new type of screw driver named the Tool Holder. This screw driver is similar in construction to standard type screw drivers except at the blade end. This end consists of a chuck forged on to the blade for

The Tool Holder Bits May Be Easily Replaced When They Become Worn

receiving bits. The Tool Holder is equipped with five steel bits, the shanks of which fit into the chuck of the Tool Holder. The bits come in two sizes for Phillips type screws and three sizes for slotted-head screws and can be easily removed and interchanged. It is said that this type of screw driver is economical because when the tip becomes worn, all that is needed is to order a new bit.

Insulated Cranes

THE Cullen-Friestedt Company, Chicago, has provided a protective device for its Burro cranes, which permits them to be used under overhead catenary systems in electrified territory. The protection consists of a welded pipe frame mounted on insulators, which, in turn, are mounted on lateral steel supports welded to the lower edge of the crane boom. In addition, the crane boom is bent downward near the cab to facilitate operation with a low boom under the charged wires or other overhead obstructions. The insulated pipe frame protects the boom and cables and permits the crane operator to work without fear of touching charged wires of the catenary system.

One of the Burro Cranes Equipped With An Insulated Guard For Work in Electrified Track Territory

Flexrock Improves Floor Resurfacer

RUGGEDWEAR Resurfacer, a floor covering and patching material manufactured by the Flexrock Company, Philadelphia, Pa., has been improved by the addition of chrysotile, a fibrous rock, which replaces the asbestos fiber that was formerly used in this product. It is said that chrysotile fibres are resistant to all ordinary acids, are twice as strong as asbestos fibres, are waterproof, and that they will not rot or disintegrate in any way. For these reasons it is claimed that the improved Ruggedwear Resurfacer makes a tougher floor surface than heretofore and that the feather edges that are formed when patching concrete are also much tougher.

New-Type Form Liner

THE Celotex Corporation, Chicago, has developed a new absorptive form liner board which is said to make concrete surfaces harder, denser, smoother and more resistant to abrasion. The form liner consists of a cane fibre board ½ in. thick which has been specially treated and ironed on one side to provide a smooth concrete surface. It comes in 4-ft. widths and lengths of 6, 8, 10 and 12 ft.

The absorptive form liner is said to improve the surface of the concrete by absorbing the air bubbles from the surface, preventing pitting and sand streaks, and by absorbing the excess water from the concrete near the surface, which reduces the water-cement ratio, producing a surface of superior smoothness, hardness and durability.

New Books

Proceedings, Wood Preservers' Association

PROCEEDINGS of the American Wood-Preservers' Association for 1940. 506 pages, 6 in. by 9 in. Illustrated. Bound in cloth. Published by the Association, 1427 Eye Street, N.W., Washington, D.C. Price $6.

This volume contains thirty-five papers and committee reports, together with the discussions that followed, which were presented at the thirty-sixth annual convention of the association at St. Louis, Mo., in January. These reports and papers cover a wide range of subjects relating to the treatment of wood to make it resistant to decay and attack by insects or to render it fireproof.

Among the papers of special interest to maintenance men were those on What We Can Expect from Treated Ties, by G. W. Harris, chief engineer, Atchison, Topeka & Santa Fe; Preframing Treated Timber for Use in Bridges, by G. H. Trout, bridge engineer, Union Pacific; Stacking, Seasoning and Treatment of Gum Lumber for Railroads, by G. R. Smiley, chief engineer, Louisville & Nashville; Still More Diversified Uses of Treated Wood by the Railroads, by Elmer T. Howson, vice-president, Simmons-Boardman Publishing Corporation, and editor, *Railway Engineering and Maintenance;* Zinc Chloride—Petroleum Treatment for Ties, by E. R. Boller, chemist, Grasselli Chemicals department, E. I. DuPont de Nemours & Company; and An International Termite Exposure Test—Eleventh Progress Report, by Geo. M. Hunt, Forest Products Laboratory and T. E. Snyder, bureau of entomology and plant quarantine, United States Department of Agriculture. Other papers and reports contain much valuable information with respect to preservative treatments and uses of treated woods in related fields.

NEWS of the Month

Labor Asks Dismissal Pay for Abandonments

The so-called Washington agreement which provides for dismissal compensation for railroad employees displaced by mergers or consolidations should be extended to cover displacements covered by abandonments, according to a proposal sponsored by the Railway Labor Executives Association and submitted to J. J. Pelley, president of the A. A. R., in a letter by James A. Phillips, chairman of the R.L.E.A., asking for a conference.

University Abandons Railway Engineering Department

The University of Illinois has abolished its Railway Engineering Department, effective with the present college year, and is distributing among other departments the more than 25 courses heretofore offered in railway engineering. This brings to a close a department organized in 1906, at which time it is said to have been the first distinctly railway engineering department in a university. In the 33 years in which this department has functioned, 287 men have been graduated.

I. C. C. Establishes Bureau of Water Carriers

The Interstate Commerce Commission has established a Bureau of Water Carriers for the administration of the water-carrier regulatory provisions of the Transportation Act of 1940. The bureau, however, according to Secretary W. P. Bartel, "will not be comparable with the Bureau of Motor Carriers in the range and volume of its activities.—The ground to be covered under Part III is less extensive than under Part II, the number of carriers to be regulated is far smaller, and the carriers are also better organized and more accustomed to regulation."

52,685 Freight Cars Placed In Service in Nine Months

Class I railroads put in service 52,685 new freight cars in the first nine months of 1940, as compared with 14,704 new freight cars in the same period last year. On October 1, Class I railroads had 16,892 new freight cars on order, compared to 25,053 on order on October 1, 1939. The new cars on order on October 1 included 9,423 box, 7,364 coal, eight stock and 97 flat cars. On October 1, Class I railroads also had 215 new locomotives on order, of which 130 were steam and 85 electric and Diesel-electric, as compared with 108 on order on October 1 last year, of which 68 were steam and 40 were electric and Diesel-electric.

Bill Introduced For Changes In Railroad Adjustment Boards

A bill sponsored by the American Short Line Railroad Association has been introduced in the Senate by Senator Smith, of South Carolina, which would establish important changes in the National Railroad Adjustment Board provisions of the Railway Labor Act. Some of the important features of the bill, which is designed "solely and simply to provide for ordinary fair play," are: the creation of a new board of 30 members, of which 10 are to be selected by the railroads and 10 by the employee organizations and 10 are to be appointed by the President; the board would be required to conduct its proceedings so as to accord procedural due process; the awards are to be required to state findings of fact upon which they are based, and provision is made for judicial review of the awards of the Board.

September Employment 4.49 Per Cent Above Last Year

Railroad employment increased from 1,059,364 to 1,066,612 during the one-month period from mid-August until mid-September, while the September total was 4.49 per cent above that for September, 1939, according to the Interstate Commerce Commission's compilation, based on preliminary reports. September employment was slightly above that of August in all groups, except those embracing executives, officials and staff assistants (down 0.12 per cent), and professional clerical and legal (down 0.03 per cent). Meanwhile all other groups showed increases above September, 1939, the largest rise being in the maintenance of equipment and stores group, which was up 7.37 per cent. Next in turn came maintenance of way and structures, up 5.99 per cent.

Government Operation Not Necessary This Time

A recurrence of the clogged condition of transportation facilities that existed in 1918 will not occur during the execution of the nation's present defense program, according to C. H. Buford, vice-president of the Operations and Maintenance department of the Association of American Railroads in a speech at Spokane, Wash., on September 20. The difficulties in 1918, "were not due to a lack of transportation facilities, but were the result of a failure of government agencies and business generally to use the railroad equipment and plant for transportation purposes. Taking sufficient freight cars to fill five tracks extending from New York to San Francisco and loading them with commodities that could not be unloaded, thereby tieing up more than 400 million dollars worth of equipment, was more than the plant could stand.

"The previous experiment in government operation of railroads was so expensive and unsatisfactory that all parties, including government, business and the railroads, should endeavor to so plan and organize that it will not be necessary to try it again.—The railroads and the War Department have been working for years on various plans and have definite agreements as to methods to be used to prevent any delay in the movement of freight either in peace-time or war."

Compares Rail and Air Safety Records

In a statement appearing in the appendix to the October 2 issue of the Congressional Record, Representative Van Zandt of Pennsylvania stated, "The air lines have made very commendable strides in recent years in the safety of passenger movement, but their passenger fatality rate is still many times greater than that of the railroads. . . . If we limit the air line figures to domestic operations, there were nine passenger fatalities in 1939, or exactly one-third as many as on the railroads. However, the railroads carried 262 times as many passengers as did the air lines and carried them an aggregate distance 33 times as great. In other words, in domestic air line operations in 1939 there was one passenger fatality for each 75,000,000 passenger-miles; on the railroads there was one passenger fatality for each 840,000,000 passenger-miles.

"The air lines make much of the fact that over a certain period they carried 2,500,000 passengers a distance of more than 1,000,000,000 passenger-miles without a passenger fatality. Let us see what the railroads have done in some recent months. . . . In March, 1940, they carried 36,000,000 passengers a distance of 1,800,000,000 passenger-miles without a passenger fatality. During May and June, 1940, they carried 74,000,000 passengers a distance of 3,750,000,000 passenger-miles without a passenger fatality."

Personal Mention

General

H. H. Vaughn, assistant supervisor of track on the Middle division of the Pennsylvania, has been promoted to assistant trainmaster on the Conemaugh division.

Lowry Smith, office engineer of the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to assistant to the operating vice-president, with the same headquarters. Mr. Smith was born at Shelbyville, Ky., on September 4, 1884, and studied engineering for three years at the University of Kentucky. He first entered railway service on the Illinois Central during a summer vacation from school in 1901. In 1907, he returned to railway service as assistant superintendent of timber preservation on the Northern Pacific at Brainerd, Minn., later being promoted to superintendent of timber preservation, with the same headquarters. In 1917, he was promoted to assistant district engineer, with headquarters at St. Paul, Minn., and in 1925, he was advanced to office engineer. His promotion was effective October 10.

A. C. Shields, vice-president and general manager of the Pittsburg & Shawmut, and an engineer by training and experience, has been elected president and

A. C. Shields

general manager, with headquarters as before at Kittanning, Pa. Mr. Shields was born at Eldon, Iowa, and attended Iowa State College, Ames, Iowa. He entered railroad service with the Chicago, Rock Island & Pacific and served in various positions in the engineering and operating departments until 1923. He then served until 1930 as engineer maintenance of way, assistant general manager and general manager of the Denver & Rio Grande Western. From 1930 to 1937 Mr. Shields was vice-president and general manager of the Denver & Rio Grande Western at Denver, Colo. He was appointed vice-president and general manager of the Pittsburg & Shawmut in April, 1940, serving in this capacity until September 25, when he was elected president and general manager.

Corbett W. Coil, a maintenance officer by training and experience, whose promotion to assistant superintendent on the Northern Pacific, with headquarters at Duluth, Minn., was announced in the October issue, was born at Spencerville, Ohio, on May 22, 1892, and entered railway service in November, 1910, as a clerk in the freight department of the Erie at Hammond, Ind. In October, 1911, he went with the Northern Pacific as a clerk in the treasurer's office at St. Paul, Minn., in 1914, he transferred to the engineering department and in 1917 he was promoted to assistant roadmaster, later being promoted to roadmaster at Mandan, N. D. Mr. Coil was transferred to Missoula, Mont., in 1924, and to Helena, Mont., in 1926. In 1928, he was promoted to division roadmaster at Fargo, N. D. He later served as roadmaster at Mandan, division roadmaster at Spokane, Wash., roadmaster at East Grand Forks, Minn., and trainmaster at Fargo. In April, 1940, he was transferred to Minneapolis, Minn., where he was located at the time of his recent promotion.

R. W. Davis, whose promotion to trainmaster-roadmaster of the Minnesota & International (a subsidiary of the Northern Pacific) with headquarters at Bemidji, Minn., was announced in the October issue, was born at St. Paul, Minn., on October 20, 1896, and entered railway service in 1916 as a rodman on the Northern Pacific at St. Paul, Minn. During the first World War he served with the 21st Engineers of the U. S. Army, returning to his former position with the Northern Pacific in December, 1918. In May, 1921, he went with the Minnesota State Highway Department as an assistant engineer at Blue Earth, Minn., and in July, 1922, he returned to the Northern Pacific as an assistant roadmaster. Mr. Davis was appointed assistant bridge and building supervisor at Fargo, N. D., in September, 1926, and in December, 1927, he was promoted to roadmaster at Grand Forks, N. D., being transferred to Glendive, Mont., in April, 1929. He was advanced to division roadmaster, with headquarters at Glendive, in February, 1936, and in May, 1938, he was transferred to Minneapolis, Minn., being located at that point until his recent promotion on September 15.

Guy M. de Lambert, division roadmaster on the Northern Pacific at Fargo, N. D., has been promoted to trainmaster-roadmaster, with headquarters at Mandan, N. D., succeeding **R. G. Knight,** who has been promoted to trainmaster, with quarters at Billings, Mont. Mr. de Lambert was born at Brainerd, Minn., on January 28, 1891, and attended the University of Minnesota for two years. He entered railway service on May 4, 1908, as a chainman on the Northern Pacific. In June, 1910, he went with the Great Northern as a rodman, and in December, 1911, he became a resident engineer on the Canadian Northern (now part of the Canadian National). Mr. de Lambert later served as a transitman for the Minnesota State Highway Commission, and in September, 1915, he returned to the Northern Pacific, serving as an inspector and instrumentman until May, 1917, when he was promoted to assistant roadmaster at Staples, Minn. In January, 1921, he was advanced to acting roadmaster and two months later he was promoted to roadmaster, with headquarters at Duluth, Minn. He was later transferred successively to Dilworth, Minn., Fargo, N. D., and Helena, Mont., and in February, 1936, he was advanced to division roadmaster at Fargo, the position he held until his recent promotion, on October 1.

Engineering

L. W. Funk, assistant engineer on the Charleston & Western Carolina, has been appointed engineer maintenance of way, with headquarters as before at Augusta, Ga.

A. J. Witchel, assistant superintendent in charge of engineering of the Spokane, Portland & Seattle, has been appointed chief engineer, with headquarters as before at Portland, Ore., a change of title.

Leigh B. Elliott, division engineer on the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), with headquarters at Springfield, Ohio, has been appointed division engineer on the New York Central, with headquarters at Cleveland, Ohio, succeeding **Howard B. Lincoln,** whose death on October 8, is announced elsewhere in these columns.

N. W. McCallum, division engineer on the New York Central, with headquarters at New York, has been appointed assistant chief engineer of the Pittsburgh & Lake Erie, with headquarters at Pittsburgh, Pa., to succeed **George H. Burnette,** whose appointment as president of the Cambria & Indiana was announced in the September issue.

J. L. Parker has been appointed division engineer maintenance of way on the Atlantic Coast Line, with headquarters at Savannah, Ga., to succeed **J. W. Hale,** whose appointment as roadmaster is noted elsewhere in these columns. L. E. Bates, has been appointed senior assistant engineer, with headquarters also at Savannah.

R. R. Brockway has been appointed assistant bridge engineer of the Northern Pacific, a newly created position, with headquarters at St. Paul, Minn., and **L. B. Curtiss** has been appointed architect, with headquarters at St. Paul, succeeding **O. M. Rognan,** who has been relieved because of poor headth, but will continue to act in an advisory capacity.

R. W. Putnam, assistant division engineer on the Southern Pacific, with headquarters at Portland, Ore., has been promoted to division engineer of the Rio Grande division, with headquarters at El Paso, Tex., succeeding **F. A. Feikert,** who has been transferred to the Salt Lake division, with headquarters at Ogden, Utah. Mr. Feikert replaces **Otis Weeks,** who retired on November 1.

Thomas Webb Brown, whose promotion to district maintenance engineer on the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, was announced in the September issue, was born at Edgerton, Mo., on October 1, 1878, and entered railway service on the Rock Island in 1892 as a section laborer at Rose

Hill, Iowa. In 1899, he was promoted to section foreman at Brighton, Iowa, and two years later he was advanced to extra gang foreman on the Missouri division, serving in that capacity and as section foreman at Washington, Iowa, until De-

Thomas Webb Brown

cember 26, 1911, when he was promoted to roadmaster at Washington. Mr. Brown was transferred to Estherville, Iowa, in 1913, and was later transferred to Centerville, Iowa; Trenton, Mo.; and Des Moines, being located at the latter point at the time of his recent promotion.

J. N. Grim, division engineer of the River division of the New York Central at Weehawken, N.J., has been transferred to the Eastern division at New York, succeeding **J. H. Kelly,** who has been transferred to the Electric division, with the same headquarters. **R. R. Smith,** supervisor of track at Batavia, N.Y., has been promoted to division engineer of the Pennsylvania division at Jersey Shore, Pa., succeeding **E. J. Bayer,** who has been transferred to the River division at Weehawken, N.J. **E. M. Skelton,** assistant supervisor of track of Subdivision 10 of the Syracuse division, with headquarters at Lyons, N.Y., has been promoted to assistant division engineer of the Pennsylvania division, with headquarters at Jersey Shore, Pa., to succeed **R. L. Sahm,** whose appointment as supervisor of track is noted elsewhere in these columns.

W. E. Cornell, division engineer of the Buffalo and Cleveland divisions, Nickel Plate district, of the New York, Chicago & St. Louis, with headquarters at Conneaut, Ohio, has been promoted to engineer of track, a newly created position, with headquarters at Cleveland, Ohio, **H. F. Whitmore,** division engineer of the Clover Leaf district, has been transferred to the Lake Erie and Western district, with headquarters as before at Frankfort, Ind., succeeding **Charles R. Wright,** whose promotion to assistant chief engineer, with headquarters at Cleveland, was announced in the October issue, and **R. E. Oberdorf,** assistant district engineer on the Lake Erie and Western district, has been appointed division engineer of the Clover Leaf district, with headquarters at Frankfort, replacing Mr. Whitmore. **Ernest R. Taylor,** chief draftsman in the chief engineer's office at Cleveland, has been promoted to division engineer of the Buffalo and Cleveland divisions, with headquarters at Conneaut, relieving Mr. Cornell.

Harold Robert Peterson, assistant engineer on the Northern Pacific at St. Paul, Minn., has been promoted to office engineer, with the same headquarters, succeeding **Lowry Smith,** whose promotion to assistant to the operating vice-president, with headquarters at St. Paul, is announced elsewhere in these columns. Mr. Peterson was born at Minneapolis, Minn., on September 5, 1896, and graduated in engineering from the University of Minnesota in 1918. He entered railway service on November 21, 1918, as a draftsman in the engineering department of the Northern Pacific at St. Paul. On February 7, 1920, he resigned to go with Foltz, King and Day, consulting engineers, but returned to the Northern Pacific ten weeks later as a structural draftsman in the bridge department. In 1925, he was appointed an inspector on bridge construction work, and in 1926 he was promoted to resident engineer on new line construction. Mr. Peterson was advanced to assistant engineer on grade separation

Harold Robert Peterson

work in 1928, and has continued as an assistant engineer, assigned to field, construction or office work since that time, with the exception of 1936 and 1937, when he was on a special assignment with the Spokane, Portland & Seattle.

C. A. Maxeiner, whose promotion to division engineer of the St. Lawrence, Adirondack and Ottawa divisions of the New York Central, with headquarters at Watertown, N.Y., was announced in the October issue, was born at Albany, N.Y., on October 18, 1894, and graduated in civil engineering from Cornell university. During summer vacations while attending college, he served with the New York Central in various capacities, and on February 6, 1918, following his graduation, he became a rodman in the office of the division engineer at Albany, becoming a draftsman in the same office two months later. On April 27, 1918, he left railroad service to join the United States Army, returning to the New York Central on September 15, 1919, as a transitman at Albany. On June 1, 1925, he was appointed assistant supervisor of track at Fonda, N.Y., being further advanced to assistant engineer at Oswego, N.Y., on October 1, 1927. Three years later he was transferred to Watertown, N.Y., and on May 1, 1933, he was promoted to supervisor of track on the St. Lawrence division, with headquarters at Carthage, N.Y. On June 1, 1936, he was transferred to Syracuse, where he was located at the time of his recent promotion to division engineer.

S. R. Hursh, engineer maintenance of way of the Eastern Pennsylvania division of the Pennsylvania, has been appointed acting chief engineer maintenance of way of the Eastern region, relieving **H. H. Garrigues,** who has been granted a leave of absence because of illness, and **J. M. Fox,** division engineer of the New York division, with headquarters at Jersey City, N.J., has been promoted to engineer maintenance of way of the Eastern Pennsylvania general division, succeeding Mr. Hursh. **D. E. Rudisill,** division engineer of the St. Louis division, with headquarters at Terre Haute, Ind., has been transferred to the New York division, replacing Mr. Fox, and **G. M. Hain,** division engineer of the Toledo division, with headquarters at Toledo, Ohio, has been transferred to the St. Louis division, relieving Mr. Rudisill. **David Emery Smucker,** assistant division engineer of the Fort Wayne division, has been promoted to division engineer of the Toledo division, succeeding Mr. Hain. **T. E. Boyle,** main line supervisor on the Philadelphia Terminal division, with headquarters at Philadelphia, Pa., has been advanced to assistant division engineer of the Fort Wayne division, succeeding Mr. Smucker. A biographical sketch of Mr. Smucker was published in the September issue, page 586, following his promotion to assistant division engineer.

Mr. Fox was born in Bucks County, Pa., in 1892. He was graduated in civil engineering from Princeton University in 1915 and began railroad work in July of that year as a chainman on the Baltimore division of the Pennsylvania. After serving in various capacities on several divisions, Mr. Fox was assigned to the office of the chief electrical engineer at Philadelphia in 1935. He became division engineer of the New York division at Jersey City,

J. M. Fox

N.J., on February 1, 1938, the position he held until his recent appointment as engineer maintenance of way of the Eastern Pennsylvania division.

Mr. Boyle was born at Crawfordsville, Ind., on June 5, 1907, and was graduated

from Notre Dame university in 1928. In August of that year he entered railroad service with the Pennsylvania as an assistant on the engineering corps on the Toledo division, and in July, 1930, he was promoted to assistant supervisor on the Fort Wayne division. In October, 1931, he returned to the Toledo division as assistant on the engineering corps, and in March, 1932, he was transferred back to the Fort Wayne division. In May, 1932, he was appointed foreman on the Western Region welding train, and in September, 1933, he was promoted to assistant supervisor on the Columbus division. One month later, he was appointed acting supervisor on the Cincinnati division, and in January, 1934, he was transferred to the Indianapolis division. In April of that same year he became an assistant supervisor on the New York division, and in June, 1936, he was promoted to supervisor on the Pennsylvania-Reading Seashore Lines, with headquarters at Camden, N.J. Mr. Boyle was transferred to the Philadelphia Terminal division in March, 1938, where he was located until his recent promotion.

John L. Gressitt, chief engineer maintenance of way of the Western region of the Pennsylvania, with headquarters at Chicago, has been promoted to assistant chief engineer of maintenance of way, system, with headquarters at Philadelphia, Pa., succeeding **Robert Faries,** whose death on September 8, was announced in the October issue. **Charles G. Grove,** engineer maintenance of way of the Southwestern general division, with headquarters at Indianapolis, Ind., has been advanced to chief engineer maintenance of way, of the Western region, relieving Mr. Gressitt. **Walter R. Parvin,** division engineer in the office of the chief engineer of the system at Philadelphia, has been promoted to engineer maintenance of way of the Southwestern general division, with headquarters at Indianapolis, replacing Mr. Grove. A biographical sketch and photograph of Mr. Grove were published in the July issue, page 463, following his promotion to engineer maintenance of way of the Southwestern general division on June 16, 1940.

Mr. Gressitt was born at Baltimore, Md., on April 4, 1887, and was educated at the Baltimore Polytechnic Institute and at Lehigh University, graduating from the latter with a degree in civil engineering. He entered railway service on August 4, 1908, on the engineering corps of the Pittsburgh division of the Pennsylvania, being advanced through the positions of chainman, rodman and transitman. On May 1, 1915, he was promoted to assistant supervisor of track on the Bellwood division, later serving in this position at Williamsport, Pa., and at Philadelphia. From October 1, 1917 to July 10, 1919, he was in military service with the 21st Engineers. After the war he returned to the service of the Pennsylvania as acting supervisor on the Monongahela division, later being promoted to supervisor, in which capacity he served during the next seven years on the Monongahela, Philadelphia Terminal and Pittsburgh divisions. He was promoted to division engineer of the Fort Wayne division on January 16, 1927, being further advanced to superintendent of the Sunbury division, with headquarters at Sunbury, Pa., on December 1, 1929. On June 1, 1931, he was transferred to the St. Louis division at Terre Haute, and on November 1, 1931, he was promoted to general superintendent of the Southwestern division, with headquarters at Indianapolis. Mr. Gressitt was transferred to Chicago two years later, and on January 1, 1936, he was promoted to chief engineer maintenance of way of the Western region, with the same headquarters, the position he held until his recent promotion, which was effective October 1.

John L. Gressitt

Walter R. Armstrong, Jr., whose promotion to chief engineer of the Nevada Northern, with headquarters at East Ely, Nev., was announced in the September issue, was born at Chihuahua, Mexico, on March 3, 1903, and attended the University of Utah from 1920 to 1922 and Dartmouth College from 1922 to 1925. He entered railway service in 1915, as a messenger at the general office of the Salt Lake & Utah at Salt Lake City, Utah, and during summer vacations from school from 1916 to 1919, worked on the Union Pacific as a laborer, trucker and mail clerk in the general office. In the summer of 1920, he worked for the Uintah Railroad as a chainman on location and the summers of 1921, 1922 and 1923 he worked on the Union Pacific (South-Central and Northwestern districts) as a bridgeman on steel erection, a rodman on maintenance of way and a topographer on location surveys. In the summer of 1924, he worked for the Southern Pacific as a rodman on location and after graduation returned to that road as a rodman and estimator at San Francisco, Cal. In November, 1926, he was transferred to Bakersfield, Cal., and in January, 1928, he returned to the Union Pacific as an assistant roadmaster on the Los Angeles division. Mr. Armstrong later served as an assistant engineer and transitman on the Kansas division at Salina, Kan., and in June, 1930, he was appointed a switchman in the yard at Salina. In August, 1930, he went with the Western Pacific as a transitman and draftsman on the construction of the line from Keddie, Cal., to Bieber. In May, 1932, he was appointed a section foreman on the Western division and in 1937 he was promoted to roadmaster at Keddie, Cal. Mr. Armstrong went with the Nevada Northern as supervisor of maintenance, with headquarters at East Ely in April, 1938, which position he held until his promotion.

Track

J. R. Brosnan, track supervisor on the Southern at Dayton, Tenn., has been transferred to East St. Louis, Ill., succeeding **L. Woodall, Jr.,** who, in turn, has been transferred to Dayton, replacing Mr. Brosnan.

Howard F. Larson, section and extra gang foreman on the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to roadmaster, with headquarters at Mitchell, S.D., succeeding **P. McMahan,** who has retired.

William Paige, bridge and building foreman on the Edmonton division of the Canadian National, has been promoted to roadmaster, with headquarters at Edmonton, Alta., succeeding **O. Hanson,** who has retired.

J. W. Hale, division engineer maintenance of way on the Atlantic Coast Line, with headquarters at Savannah, Ga., has been appointed roadmaster with headquarters at Dillon, S.C., to succeed **J. M. Tuten,** who has retired, effective October 1.

W. E. Blix, assistant supervisor of track on the New York division of the Pennsylvania, has been promoted to supervisor of track on the Williamsport division, with headquarters at Lock Haven, Pa., where he succeeds **L. W. Green,** who has been transferred to the Philadelphia Terminal division. Mr. Green succeeds **T. E. Boyle,** whose promotion to assistant division engineer of the Fort Wayne division is noted elsewhere in these columns.

R. C. Billet, assistant supervisor of track on the New York Central at Cleveland, Ohio, has been promoted to supervisor of track, with headquarters at Bucyrus, Ohio, succeeding **H. M. Fox,** who retired on September 30. **Gerald Chambers,** assistant supervisor of track at Alliance, Ohio, has been transferred to Cleveland, replacing Mr. Billet, and **James Carey,** extra gang foreman at Cleveland, Ohio, has been promoted to assistant supervisor of track at Alliance, relieving Mr. Chambers.

Lyle Bristow, whose promotion to track supervisor on the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), with headquarters at Harrisburg, Ill., was announced in the September issue, was born at Indianapolis, Ind., on January 28, 1902, and graduated in civil engineering from Purdue University in 1926. He entered railway service on June 6, 1926, as an assistant engineer on the Cleveland-Indianapolis division of the Big Four at Galion, Ohio, and later served in that capacity on the Cairo-Terre Haute, the Chicago, and the Ohio divisions.

Elbert H. Hayes, whose promotion to roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, was announced in the September issue, was born at Creston, Iowa, on October 17, 1900, and entered railway service on June 1, 1921, as a section laborer on the Rock Island. On June 1, 1925, he was promoted to section foreman and

served as extra gang and section foreman until April, 1938, when he was promoted to track supervisor. Mr. Hayes was appointed acting roadmaster in February, 1939, and in April, 1940, he was appointed assistant roadmaster in charge of one of the system rail-laying gangs, the position he held until his recent promotion.

J. P. Mumford, track supervisor on the Chattanooga (Tenn.) terminals of the Southern, has been transferred to Oakdale, Tenn., succeeding **R. J. Stone,** who has been promoted to assistant trainmaster. **R. B. Rust, Jr.,** track supervisor at Selma, Ala., has been transferred to Chattanooga, replacing Mr. Mumford, and **S. T. Montgomery,** assistant to the roadmaster at Somerset, Ky., has been promoted to track supervisor at Selma, relieving Mr. Rust. **W. C. Johnson,** assistant supervisor at Louisville, Ky., has been advanced to assistant to the roadmaster at Somerset, succeeding Mr. Montgomery, and **J. E. Nitzschke,** student apprentice, has been promoted to assistant supervisor at Louisville, replacing Mr. Johnson.

C. Breth, whose promotion to supervisor of track of Subdivision 32 of the Adirondack division of the New York Central, with headquarters at Malone, N.Y., was announced in the October issue, was born at Mahaffey, Pa., on April 27, 1896, and entered the service of the New York Central on June 19, 1922, as an extra gang laborer. On March 1, of the following year he was made an assistant foreman at Mahaffey, being advanced to section foreman at the same point on September 1, 1924. During the following six years, Mr. Breth held various positions in the maintenance department, including those of section foreman, relief foreman, extra gang foreman and timekeeper. On January 1, 1930, he was promoted to assistant supervisor of track at Cherry Tree, Pa., being transferred to Mahaffey on September 1, 1931. Subsequently he was transferred to Brewster, N.Y., and thence to Harmon, N.Y., where he remained until his recent promotion.

William N. Myers, assistant supervisor of track on the Pennsylvania, whose promotion to supervisor of track, with headquarters at New Castle, Pa., was reported in the October issue, was born on June 6, 1912, at Cumberland, Md., and obtained his higher education at Johns Hopkins university, graduating in 1933 with a degree in civil engineering. He entered railway service with the Pennsylvania on July 16, 1934, as an assistant on the engineering corps at Cleveland, Ohio. Subsequently, he served in the same capacity at Alliance, Ohio, Pittsburgh, Pa., Derry, Pa., and Buffalo, N.Y. On April 7, 1936, Mr. Myers was promoted to assistant supervisor of track with headquarters at Cleveland, Ohio, later being transferred successively to Wooster, Ohio, and Steubenville, Ohio. He was located at the latter point at the time of his promotion to supervisor of track at New Castle, which was effective September 1.

Gale B. Aydelott, whose promotion to roadmaster on the Denver & Rio Grande Western, with headquarters at Walsenburg, Colo., was announced in the September issue, was born at La Grange, Ill., on July 22, 1914, and attended the University of Illinois from 1932 to 1936. He entered railway service on July 2, 1936, as a welder helper on the D. & R. G. W., and later served for a short time as an extra gang laborer and a chainman in the engineering department. On September 15, 1936, he was appointed assistant extra gang foreman and on March 14, 1937, he was appointed track inspector on the Pueblo division. From November 21, 1938 to March 1, 1939, Mr. Aydelott served as engineering assistant and then until September 1, 1939, as assistant roadmaster on the Grand Junction division. He was appointed track inspector on the Deer Creek project at Provo, Utah, on the latter date, and on January 1, 1940, he was re-appointed assistant roadmaster on the Grand Junction division.

R. L. Sahm, assistant division engineer on the Pennsylvania division of the New York Central, with headquarters at Jersey Shore, Pa., has been appointed supervisor of track of Subdivision 27 of the same division, with headquarters at Clearfield, Pa., to succeed **F. B. Wilcox,** who has been transferred to Subdivision 12 of the Buffalo division, with headquarters at Batavia, N.Y., where he replaces **R. R. Smith,** whose promotion to division engineer at Jersey Shore is noted elsewhere in these columns. **E. I. Wilson,** extra gang foreman, has been promoted to assistant supervisor of track of Subdivision 25 of the Pennsylvania division, with headquarters at Wellsboro Junction, Pa., to succeed **G. S. Wooding,** who has been transferred to Subdivision 10 of the Syracuse division, with headquarters at Lyons, N.Y., where he replaces **E. M. Skelton** whose appointment as assistant division engineer at Jersey Shore is noted elsewhere in these columns. A biographical sketch of Mr. Sahm was published in the July, 1940, issue, page 463, on the occasion of his appointment as assistant division engineer at Jersey Shore, Pa.

Harvey W. Johnstone, assistant bridge and building supervisor on the Northern Pacific at Glendive, Mont., has been promoted to branch line roadmaster at Fargo, N.D., succeeding **L. H. Dahl,** who has been promoted to main line roadmaster at Mandan, N.D. Mr. Dahl replaces **Fred M. Schaumberg,** who has been advanced to division roadmaster, with headquarters at Glendive, Mont., relieving **H. O. Whitten,** who has been transferred to Fargo. Mr. Whitten succeeds **G. M. de Lambert,** whose promotion to trainmaster-roadmaster, with headquarters at Mandan, is announced elsewhere in these columns.

W. F. Monahan, general track inspector of the Southern Pacific, Pacific Lines, with headquarters at San Francisco, Cal., has been appointed general track supervisor, a change of title. **E. E. Earl,** construction superintendent at Redding, Cal., has also been appointed general track supervisor, a newly created position. **L. R. Adams** has been appointed roadmaster at Douglas, Ariz., succeeding **E. B. Lohr,** who has been transferred to Fresno, Cal., replacing **C. Donovan.** Mr. Donovan has been transferred to Oakland Pier, Cal., relieving **J. O'Hara,** who has retired. **E. M. Montford** has been appointed roadmaster at Carrizozo, N.M., succeeding **M. T. Pruett,** who has been transferred to Bowie, Ariz., replacing **G. L. Lambert.** Mr. Lambert has been transferred to Klamath Falls, Ore., relieving **J. J. Doyle,** who has been transferred to Oakridge, Ore., succeeding **E. E. Edwards. B. F. Pennington,** roadmaster at Ventura, Cal., has been transferred to Yuma, Ariz., replacing **G. L. Blair,** who has been transferred to Phoenix, Ariz., relieving **J. Stewart.** Mr. Stewart has been transferred to Los Angeles, Cal., succeeding **G. L. Morrison,** who has been assigned to other duties. **J. J. Kennedy** has been appointed roadmaster at Dunsmuir, Cal., relieving **J. O. Johnson,** who has been assigned to other duties.

Bridge and Building

J. A. Gallagher has been appointed acting bridge and building supervisor of the Atlanta division of the Nashville, Chattanooga & St. Louis, with headquarters at Kingston, Ga., succeeding **W. C. Roach.**

O. A. Hanson has been appointed assistant bridge and building supervisor on the Northern Pacific at Glendive, Mont., succeeding **Harvey W. Johnstone,** whose promotion to roadmaster at Fargo, N.D., is announced elsewhere in these columns.

M. A. Beringer, bridge and building foreman on the Vicksburg division of the Illinois Central, has been promoted to supervisor of bridges and buildings, with headquarters at Vicksburg, Miss., succeeding **C. W. Boyce,** who has been assigned to other duties.

J. A. Lewis, bridges and building inspector on the Syracuse division of the New York Central, with headquarters at Rochester, N.Y., has been promoted to assistant supervisor of bridges and buildings of the Mohawk division, with headquarters at Utica, N.Y., where he succeeds **I. Vosburgh,** who has been promoted to supervisor of bridges and buildings of the Eastern division with headquarters at Beacon, N.Y. Mr. Vosburgh succeeds **K. L. Miner,** who has been transferred to the Mohawk division with headquarters at Albany, N.Y., to replace **W. B. Burke** who has retired. These changes became effective on October 16.

Mark Henninger Corbyn, whose promotion to master carpenter on the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa, was announced in the September issue, was born at Lincoln, Neb., on September 6, 1899, and graduated in civil engineering from the University of Nebraska in 1921. He entered railway service on September 1, 1924, as a chainman on the Rock Island at Fairbury, Neb., and later served in that capacity at Des Moines, Iowa and Chicago. On July 1, 1925, he was promoted to rodman at Fairbury and on May 13, 1929, he was advanced to instrumentman at Rock Island, Ill. On November 11, 1929, he was assigned to location and construction work on the Coburn, Mo. to Birmingham line, as a rodman, later serving as a draftsman and office engineer, with headquarters at Trenton, Mo. On April 1, 1932, he was appointed a rodman at Cedar Rapids and

(Continued on page 786)

POZZOLITH SAVES MONEY

Where speed is essential, Pozzolith produces High Early Strength promoting early stripping of forms and finishing. Pozzolith concrete is noted for the great increase in placeability over plain concrete, at a given water cement ratio.

Since Pozzolith concrete requires 15% to 20% less water to get complete placeability and thorough hydration this type of concrete has less "water gain" and a higher percentage of pores "closed."

In other words Pozzolith concrete is more durable and more proof against the disintegration of freezing and thawing cycles. That leading railroad engineers use it again and again is evidence of its high value.

EMBECO SAVES MONEY

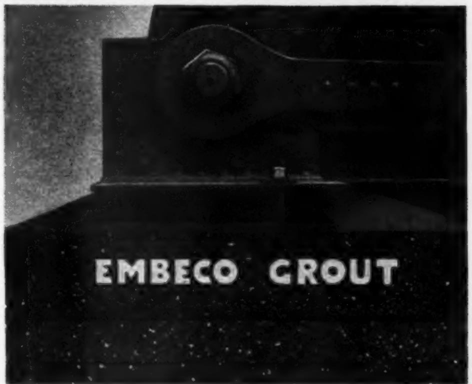
Maintenance men are recognizing the money saving value of Embeco, a specially prepared metallic aggregate with exclusive water reducing features. Embeco when mixed with sand, cement, and water expands during the setting, eliminating shrinkage, cracking, and porosity that lead to disintegration.

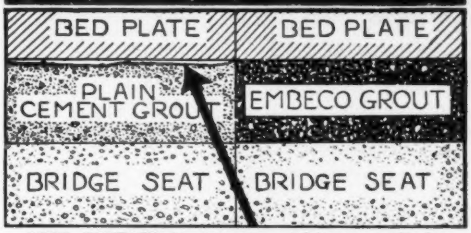
Embeco saves money by creating more durable grouting and permanent concrete repairs; by preventing the loss due to complete disintegration of your initial investment, by lowered labor cost, less material cost; through less delay in traffic schedules because of Embeco's ability to shorten maintenance time on the job.

For complete information on these "TWIN $ SAVERS" ask for bulletins. Send for this valuable data that shows how to save money and time.

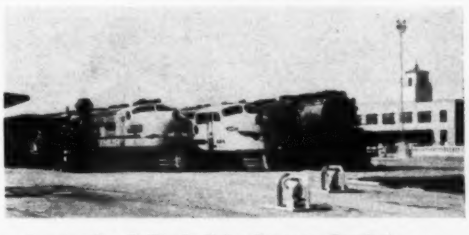
THE MASTER BUILDERS COMPANY

Cleveland, Ohio **Toronto, Canada**





POOR CONTACT due to mortar shrinkage, permits increased vibration and rapid disintegration. Embeco produces a lasting bearing surface.



Los Angeles, California Union Passenger Terminal . . . . Masterbuilt Products Used . . . .

MASTER BUILDERS

in May, 1936, he was appointed a bridge and building inspector at Des Moines, later being transferred successively to Rock Island; Cedar Rapids; Agua, Okla.; Fairfield, Iowa and to the Oklahoma and Panhandle divisions. On April 1, 1939, Mr. Corbyn was appointed a draftsman at Chicago, and on September 20, 1939, he was re-appointed bridge and building inspector, serving on the Southern, Des Moines and Missouri-Kansas divisions, until his recent promotion.

Special

John Douglas has been appointed assistant scale inspector of the Denver & Rio Grande Western at Salt Lake City, Utah, a newly created position.

Obituary

David Mau, a former roadmaster on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, who retired in 1928, died at his home in Chicago on October 17.

T. E. Downard, supervisor of bridges and buildings on the Illinois Central, with headquarters at Paducah, Ky., died suddenly of a heart attack at Princeton, Ky., on October 15.

William Benson Storey, former chief engineer of the Atchison, Topeka & Santa Fe System, who retired as president of that road in 1933, died of heart failure at his home in Chicago on October 24.

Henry B. Seaman, who served in important engineering capacities on a number of railroads during a long career as a civil engineer, died in New York on October 24, at the age of 79 years, following a prolonged illness. Mr. Seaman was born in New York City on January 20, 1861, and was graduated in civil engineering from Swarthmore College. Early in his career he served as a resident engineer on the construction of several lines, as a designer with the Edge Moor Iron Company, as an engineer on the construction of the Kings County Elevated Railway, Brooklyn, N. Y., and as principal assistant engineer for Wilson Brothers & Co., consulting engineers, employed by the Pennsylvania and the Reading. In 1891, he became bridge engineer of the Erie, leaving this company in 1893 to join the New York, New Haven & Hartford as construction engineer. From 1900 to 1903, he served as engineer and superintendent for the firm of Holbrook, Cabot & Daly. Returning to the New Haven in 1903, Mr. Seaman was engaged on important reconstruction work until 1905, then becoming consulting engineer for the Department of Bridges in New York City. In later years he has been associated at various times with the New York State Public Service Commission, the Bureau of Yards and Docks of the Navy Department, the Steinway Tunnel Extension in New York City, and, more recently, the Works Progress Administration.

Howard B. Lincoln, division engineer on the New York Central, with headquarters at Cleveland, Ohio, died suddenly in that city on October 8. Mr. Lincoln was born at Syracuse, N.Y., on January 4, 1889, and attended Syracuse University. He entered railway service on July 22, 1905, as a laborer on the New York Central, and on July 13, 1906, he became a chainman at Port Byron, N.Y. On June 19, 1909, Mr. Lincoln was promoted to assistant foreman, with headquarters at Syracuse, and on May 15, 1912, he was further advanced to instrumentman with the same headquarters. On June 16, 1913, he was promoted to assistant supervisor of track at Syracuse and on November 24, 1924, he was promoted to supervisor of track with headquarters at Carthage, N.Y. On August 1, 1929, he was transferred to Weehawken, N.J., and on March 16, 1933, he was advanced to general track inspector, with headquarters at New York. Mr. Lincoln was advanced to division engineer of the Pennsylvania division, with headquarters at Jersey Shore, Pa., in January, 1935, and in July, 1938, he was transferred to Cleveland, Ohio.

Duncan John Kerr, an engineer by training and experience, whose career as president of the Lehigh Valley, was halted last year by illness, died on October 8, at Spokane, Wash. Mr. Kerr was born in Glasgow, Scotland, on December 3, 1883, and graduated in civil engineering from the University of Glasgow in 1904. He came to America immediately after graduation, and in November of that year entered railway service as a rodman in the engineering department of the Pennsylvania at Altoona, Pa. Five years later he went with the Chicago, Milwaukee & Puget Sound (a subsidiary of the Chicago, Milwaukee, St. Paul & Pacific, now absorbed) on construction work, and from

Duncan John Kerr

1910 to 1913, he served on the construction of the Oregon Trunk (now the Spokane, Portland & Seattle) and the S. P. & S. In the latter year he went with the Great Northern, subsequently becoming office engineer and corporate engineer. On December 1, 1920, Mr. Kerr was appointed assistant to the vice-president in charge of operation of the Great Northern and during this period he also served as president of the Cottonwood Coal Company and the Somers Lumber Company, subsidiaries of the Great Northern. In June, 1936, he was appointed assistant to the president of the Lehigh Valley, and on May 5, 1937, Mr. Kerr was elected president. He continued in this position until illness forced him to relinquish his duties in the spring of 1939. During the time he was president of the Lehigh Valley, Mr. Kerr also served as chairman of the Committee on Public Relations of the Eastern Railroad Presidents Conference. He was the author of two books, "The Story of the Great Northern Railroad Company" and "James J. Hill," and was given the Arthur M. Wellington award by the American Society of Civil Engineers in 1933.

Arthur Comstock Watson, chief engineer of the New York Zone of the Pennsylvania and the Long Island at New York, whose death on September 23 was reported in the October issue, was born at Canton, Ohio, on July 11, 1881. He re-

Arthur Comstock Watson

ceived the degree of Bachelor of Arts at Washington & Jefferson College in 1902. Mr. Watson entered the service of the Pennsylvania as a chainman on the Erie & Ashtabula division in 1899, later leaving this work to continue his education. In July, 1902, he returned to the Pennsylvania as an assistant on the engineering corps. In April, 1903, he entered the employ of the Illinois Central, serving in various capacities, including that of assistant engineer at Vicksburg, Miss. In April, 1904, he entered the service of the Vandalia (now part of the Pennsylvania system) and subsequently served as an assistant engineer on the Indianapolis Terminal, Vincennes, Richmond, Western, Cleveland and Pittsburgh divisions. In January, 1913, he became division engineer on the Zanesville division, and later held that position on the Logansport, Cleveland and Pittsburgh divisions. In March, 1920, he was promoted to superintendent of the Richmond division and in January, 1922, he was transferred to the Schuylkill division. Mr. Watson became superintendent of the Conemaugh division in March, 1923, being transferred to the Cleveland and Pittsburgh division in January, 1926, and to the Middle division in June, 1926. In February, 1927, Mr. Watson was appointed chief engineer of the Long Island and in October, 1928, he was given the additional title of chief engineer of the New York Zone of the Pennsylvania, in which capacity he served until his death. Mr. Watson had supervision over the improvement of the Jersey City waterfront facilities, the building of the new Newark terminal and the elimination of many grade crossings on Long Island.

(Continued on page 788)

We don't have REJECTS anymore!
PITTSBURGH SCREW & BOLT
GIANT GRIP
REINFORCING DRIVE DOWELS
● No need now for rejects due to splitting! Here is an actual photograph of ties that were doweled green, and treated at end of seasoning period. In creosoting plants, ties, which show a tendency to split, can be completely salvaged before treating by using GIANT GRIPS. GIANT GRIPS are available in diameters, 1/4" to 7/8", any required length.
Samples sent upon request.
PITTSBURGH
SCREW AND BOLT CORPORATION
PITTSBURGH, PA.
GARY
SCREW AND BOLT COMPANY
GARY, IND.—CHICAGO, ILL.
American Equipment Corp. . . . . . . Norristown, Pa.
DISTRICT OFFICES: International Building, New York, N. Y. . . . . . . General Motors Building, Detroit, Michigan . . . . . . N. B. C. Building, Cleveland, Ohio . . . . . . Post Office Box 222, Savannah, Georgia . . . . . . Republic Bank Building, Dallas, Texas

Association News

Wood-Preservers' Association

The Executive Committee met in Chicago on Wednesday, October 16, to transact routine business of the association and to complete arrangements for the thirty-seventh annual convention, to be held in Louisville, Ky., on February 4-6, 1941.

Maintenance of Way Club of Chicago

More than 100 members and guests were present at the first fall meeting of the club, which was held at the Auditorium Hotel, Chicago, on the evening of October 28. The speaker was C. E. Johnston, chairman, Western Association of Railway Executives, who discussed the Labor Relations Act, with particular reference to the effect on maintenance department employees and operations of the decisions that have been rendered under this act. The next meeting of the club will be held on November 25.

Metropolitan Maintenance of Way Club

With 75 members and guests in attendance, the club held its first meeting of the season on October 24, at the Hotel Governor Clinton, New York. Following dinner, the group was addressed by J. M. Fox, engineer maintenance of way, Pennsylvania, Harrisburg, Pa., who described the practice, as employed on the Pennsylvania's four-track line between New York and Philadelphia, of providing deep side ditches as a means of lowering the water table to improve roadbed drainage.

In accordance with past practice, the next meeting of the club will be held on the afternoon of the day of the New York Railroad Club annual dinner, which will be on December 12, 1940.

American Railway Engineering Association

The Board of Direction and the Nominating committee of the association will meet in New York on November 15, and, in addition, the two following standing committees have scheduled meetings during November: Ties, at Kansas City, Mo., on November 7, and at Galesburg, Ill., on November 8; and Records and Accounts, at Indianapolis, Ind., on November 7 and 8.

Bulletin No. 420 is in the hands of the printer and will be mailed to members of the association early in the month. This bulletin will include reports of the committees on Electricity; Signals and Interlocking; Standardization; Waterways and Harbors; Uniform General Contract Forms; and Economics of Railway Location and Operation.

Twelve committees held meetings during October, three in Chicago, concurrent with the Bridge and Building Association convention to afford members an opportunity to attend sessions of the convention and to visit the exhibit of the Bridge and Building Supply Men's Association held in conjunction therewith. The committees which met included the following: Waterways and Harbors, at Chicago, October 1; Yards and Terminals, at Buffalo, N. Y., October 7-8; Highways, at Chicago, October 10; Iron and Steel Structures, at Urbana, Ill., October 10-11; Buildings, at Chicago, October 15-16; Wood Preservation, at Chicago, October 16; Wood Bridges and Trestles, at Chicago, October 16; Waterproofing, at New York, October 16; Co-operative Relations with Universities, at Ann Arbor, Mich., October 21; Water Service, Fire Protection and Sanitation, at Chicago, October 24; Economics of Railway Labor, at Chicago, October 25; and Masonry, at Chicago, October 29-30.

Supply Trade News

General

On October 1, the **Ozalid Corporation,** Johnson City, N.Y., became the **Ozalid Products Division** of the **General Aniline & Film Corporation,** with address as formerly at Johnson City.

Personal

Earl E. Thulin has been appointed representative for the **Mall Tool Company** in the Chicago territory, with headquarters at Chicago, Ill., and **C. E. Murphy** has been appointed representative for the Cleveland territory, with headquarters at Cleveland, Ohio.

Obituary

H. H. Timken, co-founder of the Timken Roller Bearing Company and chairman of the board, died in Canton, Ohio, October 14. Mr. Timken was born in St. Louis, Mo., on April 19, 1868, and graduated from the University of California law school. He went to Canton in 1901 and with his father established the Timken Roller Bearing Axle Company at Canton. In 1909 the firm took its present name. He was the first president of the Canton Chamber of Commerce and had been chairman of the board of the Hercules Motor Corporation of Canton. Mr. Timken had been president of the Timken Roller Bearing Company for 23 years and chairman of the board for 12.

H. H. Timken

Trade Publications

Silica Removal Process—The Permutit Company, New York, has published an eight-page pamphlet which is devoted to this company's Mag-de-Sil process for removing silica from boiler feed water. The pamphlet discusses the occurrence and harmful effects of silica; traces the development of the Mag-de-Sil process; and tells how it is applied.

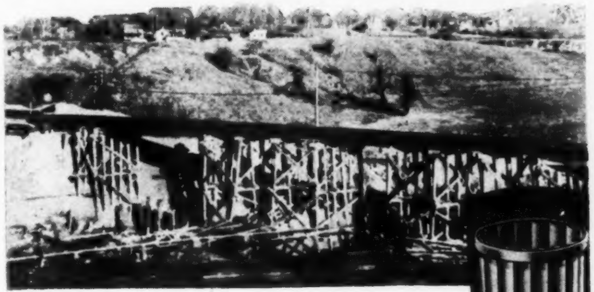
Murex Electrode Pamphlet—A new pocket-size pamphlet covering the Murex line of electrodes for arc welding has been published by the Metal & Thermit Corporation, New York, which gives complete data on the physical properties, chemical analyses, qualifications and recommended procedures for all Murex mild steel welding electrodes and similar but briefer information on Murex alloy steel electrodes.

Vibration-Damping Cable Connectors.—An eight-page bulletin has been published by the Electroline Company, Chicago, describing the improved Electroline-Fiege wire rope connectors with the built-in vibration-damping design. The bulletin describes installation methods for using the various types of connectors and lists several corrosion-resistant types. It is well illustrated by cutaway views and numerous photographs.

Airco Electric Welding Products.—Catalog 103, a 32-page booklet, has been published by the Air Reduction Sales Company, New York, describing the complete line of Airco electrodes and Wilson electric welding machines. The booklet discusses the various types of electrodes and offers information as to where each type can be used to best advantage. Welding procedure, physical properties and specification tables are also presented for each type of electrode. The booklet also describes many electric welding accessories and four types of Wilson electric welding machines.

Stainless Steel Booklets.—The Republic Steel Corporation, Cleveland, Ohio, has published four new booklets on Enduro stainless steel. Form ADV 361, a 28-page booklet, is general in nature and describes the properties and applications of Enduro in many fields of industry. Form ADV 362, a 24-page booklet, describes the properties, fabrication, corrosion-resistance and applications of Enduro 18-8 and its several variations. This booklet also contains a chart showing the specific properties of 13 of the more common types of Enduro stainless steel, as contrasted with carbon steel, and a table showing the corrosion-resistance of three types of Enduro in the presence of more than 200 corrosive media. Form ADV 363, a 24-page booklet, describes the properties, fabrication and application of four straight-chromium types of Enduro, and also contains a corrosion table and a chart of properties. Form ADV 364, a 16-page booklet, lists the properties and gives fabrication details on three heat-resisting high-strength types of Enduro.

MONOTUBES
Let You
SPEED UP
PILING WORK WITHOUT SLOWING UP TRAFFIC



● Traffic passed over this Nickle Plate trestle near Valparaiso, Ind., without interruption, despite the fact that foundation piles for a permanent underpass were being installed under a structure having a low overhead clearance. The illustration below shows how it was done. Monotube steel casings were driven in sections and spliced on the job. The only extra field work required was a fillet weld around the butt of the lower section.

Piling jobs move at a faster pace when Monotubes are used. These cold rolled, tapered steel casings are light weight for easy handling. They require no core or mandrel and can be driven speedily with standard equipment. The casings are inspected readily after installation and when filled with concrete offer superior load-carrying capacities.

There's a Monotube of a gauge, taper and length to meet every foundation need. Write for copy of Catalog No. 68A.

THE UNION METAL MFG. CO.
CANTON, OHIO

PUT THIS MONEY-SAVING COMBINATION *IN YOUR 1941 BUDGET*

SYNTRON *"HEAVY BLOW"* ELECTRIC TAMPERS

SYNTRON *"OFF-THE-TRACK"* GAS-ELECTRIC PLANT

CUT YOUR LABOR COST OF SURFACING TRACK FROM 20% TO 30%

Tamp your track quicker—more uniformly—at lower cost per mile—with the time-proved **Syntron** method. 2, 4, 6 or 8 Tool Outfits are available. Put them on the job and note the savings for yourself.

SYNTRON CO.
Homer City, Pa.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of Railway Engineering & Maintenance published monthly at Chicago, Ill., for Oct. 1, 1940.

State of Illinois }
County of Cook } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the Railway Engineering and Maintenance and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Simmons-Boardman Publishing Corp., 105 West Adams St., Chicago, Ill.; Editor, Elmer T. Howson, 105 W. Adams St., Chicago, Ill.; Managing Editor, Neal D. Howard, 105 W. Adams St., Chicago, Ill.; Business Manager, F. C. Koch, 30 Church Street, New York, N.Y.

2. That the owners are: Simmons-Boardman Publishing Corporation, 30 Church Street, New York, N.Y.; Stockholders of 1 per cent or more of the total amount of stock are: I. R. Kerfoot, 15 Hillcrest Dr., Pelham Manor, N.Y.; P. A. Lee, Hopatcong, N.J.; Henry Lee, Hopatcong, N.J.; E. G. Wright, 398 N. Walnut Street, E. Orange, N.J.; S. O. Dunn, 105 West Adams Street, Chicago, Ill.; C. E. Dunn, 3500 Sheridan Blvd., Chicago, Ill.; L. B. Sherman, 575 Sheridan Road, Winnetka, Ill.; Mae E. Howson, 105 West Adams Street, Chicago, Ill.; B. L. Johnson, 6949 Bennett Avenue, Chicago, Ill.; Spencer Trask & Company, 25 Broad Street, New York, N.Y. General partners of Spencer Trask & Company are: Edwin M. Bulkley, Walnut Street, Englewood, N.J.; Acosta Nichols, Cold Spring Road, Oyster Bay, N.Y.; Cecil Barret, Carlyle Hotel, New York, N.Y.; C. Everett Bacon, 16 Erwin Park, Montclair, N.J.; F. Malbone Blodget, 65 Patterson Ave., Greenwich, Conn.; Arthur H. Gilbert, 440 Park Ave., New York, N.Y.; Henry S. Allen, 407 Highland Ave., Orange, N.J.; William Kurt Beckers, South Salem Road, Poundridge, N.Y.; Edwin M. Bulkley, Jr., 21 Sturgis Road, Bronxville, N.Y.; J. Taylor Foster, Parsonage Lane, Greenwich, Conn.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

ELMER T. HOWSON, Editor.

Sworn to and subscribed before me this 27th day of September, 1940.

(SEAL) ANNE A. BOYD.
(My commission expires Dec. 10, 1943.)

ALPHABETICAL INDEX TO ADVERTISERS

TECO CONNECTORS *make* RAILWAY TIMBERS *do more work!*

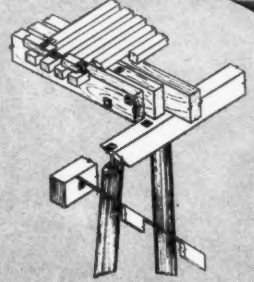
The strength and rigidity of trestle structures must keep pace with increasing speeds and heavier loads.

TECO CONNECTORS develop a much larger percentage of the inherent strength of trestle bracing members. . . . Thus, because they do more work, traditionally sized timbers can serve more rigid modern requirements.

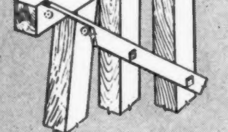
Connectors may be installed in pressure-treated material without injury to treatment and they lend themselves admirably to prefabrication and boring prior to treatment.

Clamping plate connectors prevent loosening and shifting of ties due to vibratory loads. Spike grids prevent enlargement of bolt holes as well as increasing connection strength four to six times.

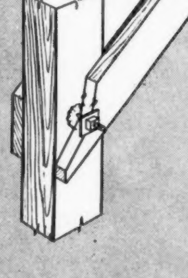
Write today for samples and further details on application of these and other connectors to railway structures. Use the coupon below.



Pile trestle bent showing the use of spike grids and clamping plates. Clamping plates are used to fasten guard rail to ties and ties to stringers, thus eliminating daps.



Timber trestle bent showing use of TECO split rings. TECO connectors between sway braces and post greatly increase the stiffening effect.



Typical sway brace connection to a column with TECO toothed rings.

Timber
ENGINEERING CO., Inc.
F-11—1337 Connecticut Avenue
Washington, D. C.

TIMBER ENGINEERING COMPANY, Inc., Dept. F-11, 1337 Connecticut Avenue, Washington, D. C.
FREE DATA Without obligation, mail us your booklet "Railway Timber Structures" explaining use of Teco Joint Connectors in railway systems.
Company ....
Individual ....
Address ....

enance